Eighth International Congress of the International Society for Cell Biology

THE date of the eighth international congress of the International Society for Cell Biology (Cytology Congress) has been changed from this year to 1954. It will be held in Leyden during September 1–7, under the presidency of Prof. E. Newton Harvey, of Princeton University, with Prof. P. J. Gaillard, of the Laboratory for Experimental Histology, University of Leyden, as secretary. Correspondence concerning the Congress should be addressed to Dr. W. H. K. Karstens, Botanical Laboratory, State University, Nonnensteeg 3, Leyden. Full members of the Society and candidates for membership approved by the International Committee are automatically entitled to attend the Congress, and to introduce two guests. Non-members are admitted as space permits, after provision has been made for members and their guests. Any member of the Society may nominate a new member from "those who have made outstanding contributions to cell biology over a period of years". The nominations, with a statement of qualifications and a list of the nominee's publications, should be sent to the secretary of the Society, Prof. J. F. Danielli, Zoology Department, King's College, London, W.C.2.

Endeavour Prizes for Science Essays

IN order to stimulate younger scientific workers to take an interest in the work of the British Association for the Advancement of Science and to raise the literary standard of scientific writing, Imperial Chemical Industries, Ltd., publishers of *Endeavour*, are offering a number of prizes for an essay, not exceeding four thousand words, on one of the following subjects: radio-astronomy; colour and chemistry; biology in world affairs; science and safety in transport; science and art; scientific contributions to medicine; scientific societies and their role; and power and civilization. Competitors must be less than twenty-five years of age and must send in their essays by June 1. The prizes will be 50, 25 and 15 guineas, respectively, with two special awards of 5 guineas for competitors less than eighteen, and in addition prize-winners will have their expenses paid for attendance at the British Association meeting to be held in Liverpool during September 2–9. Further details of these awards, which are known as *Endeavour* prizes, can be obtained from the Assistant Secretary, British Association for the Advancement of Science, Burlington House, Piccadilly, London, W.1.

University of Leeds

DONATIONS have been made to the University of Leeds as follows: £2,500 from the Cement and Concrete Association to the Department of Civil Engineering towards the cost of a universal testing machine; £1,100 from Bolton Leathers, Ltd., to the Department of Leather Industries, for the Boltonia Fellowship for 1952–53 and 1953–54; a gravity-feed stoker, valued at £1,085, from Crosthwaite Furnaces, and Scriven Machine Tools, Ltd., Leeds; and a grant of £500 a year (for one year in the first instance), with provision for superannuation purposes for half-time assistance and with up to £1,000 a year for expenses, from the Medical Research Council, to the Department of Experimental Pathology and Cancer Research, for work on the carcinogenic action of mineral oils.

Colonial Service: Recent Appointments

THE following appointments have recently been made in the Colonial Service: E. W. Momber (principal agricultural officer, Nigeria), assistant director of agriculture, Northern Region, Nigeria; B. E. V. Parham (senior agricultural officer, Fiji), deputy director of agriculture, Fiji; A. M. Anderson (fisheries officer, North Borneo), fisheries officer, Uganda; M. P. Benjamin (assistant agricultural superintendent, British Guiana), agricultural officer, Jamaica; J. O. Jaine (land ranger, Tanganyika), senior land ranger, Tanganyika; I. G. Lumsden (assistant conservator of forests, Northern Rhodesia), assistant conservator of forests, Nigeria; G. H. Rulf (assistant director of grain storage, Tanganyika), director of grain storage, Tanganyika; G. G. Rushby (senior game ranger, Tanganyika), deputy game warden, Tanganyika; E. H. Jones, agricultural officer (economist), Uganda; C. A. Waldron, agricultural officer, Tanganyika; H. I. Williams, bacteriologist, Federation of Malaya; A. Rogerson, scientific officer, East Africa High Commission; D. Bates, agricultural survey (cocoa) officer, Gold Coast; J. Forsyth, entomologist, Gold Coast; I. A. S. Gibson, mycologist, Forestry Department, Kenya; I. A. Hoffe, veterinary officer, Federation of Malaya; G. S. Scott, provincial tsetse officer, Tanganyika; W. E. Webb, senior scientific officer, forest entomologist, Timber Pest Research Unit, Gold Coast; T. W. W. Wood, assistant conservator of forests, Sarawak.

Announcements

Two Ramsay Memorial Fellowships, worth £400 a year plus a grant for expenses not exceeding £100 a year, are being offered for chemical research; they will normally be tenable for two years. One of the Fellowships will be limited to candidates educated in Glasgow. Further information can be obtained from the Joint Honorary Secretaries, Ramsay Memorial Fellowships Trust, University College, Gower Street, London, W.C.1, to whom application forms must be sent not later than April 17.

THE Ministry of Education is arranging a short course in chemistry for teachers from technical colleges, to be held in the Municipal Technical College, Coventry, during July 15–24. The instruction will deal with modern chemical techniques relating to chromatography and to semi-micro-analysis, and will consist of lectures and practical laboratory work. The course will be residential, but local teachers may be accepted as day students; the total charge for board and lodging is £8. Further information can be obtained from the Ministry of Education (Teachers Short Courses), 36–38 Berkeley Square, London, W.1.

THE British Columbia Research Council at the University of British Columbia, Vancouver, has announced the following new appointments: *Chemistry Division*: H. Friedeberg (formerly of the University of Birmingham), W. F. Gruber (University of Vienna), H. G. Khorana (University of Cambridge), J. F. Smith (Imperial College of Science and Technology, London) and J. D. H. Strickland (formerly with the Ministry of Supply in Great Britain); *Metallurgy Division*: I. D. G. Berwick (University of Cambridge), J. G. Parr (University of Liverpool) and J. E. Srawley (formerly with the British Cast Iron Research Association).

SOME SOCIAL AND PSYCHOLOGICAL PROBLEMS OF AGEING

THE programme of the British Association meeting last year in Belfast included a session by Section J (Psychology) on the problems of ageing. Mrs. M. Gilmore was in the chair. In the opening paper, which was a review of the problems of ageing in relation to medical science, read by Dr. G. F. Adams, physician to the Geriatric Department of the City Hospital, Belfast, the reasons were considered why old age should present problems in modern times any more than in the past. There has been a progressive increase, both absolute and relative, in the proportion of old people in the population, this increase being the result of the decline in infant and young adult mortality produced by the medical and social advances that have been made possible by the application of the scientific method during the past century. As a result of this, more old people must be supported by a diminished proportion of wage earners. There is a corresponding increase in the numbers of elderly invalids to be cared for, who are suffering from the degenerative diseases of old age which medical treatment may ameliorate, but not cure. Meanwhile, the expense of medical treatment, especially hospital treatment, has risen enormously and continues to rise, and it has been suggested that the community is faced with a gloomy prospect of unlimited 'medicated survival' to be met by diminishing resources. Dr. Adams disagreed with this view. Pointing out that medicine has long evaded its responsibilities to the clinical and social medicine of old age, being preoccupied in other fields of research, he outlined the new approach being made to the medical care of the elderly through the clinical work of hospital geriatric departments and the influence of social medicine in surveys of the problems of ageing. Much success has already been achieved in the prevention of unnecessary invalidism among the elderly sick, and many elderly patients hitherto regarded as 'chronic invalids' have been restored to activity, reducing the burden of nursing and domestic care otherwise necessary for them. Dr. Adams concluded that estimates of future needs for the elderly sick should be based on the results of such work rather than on limits set by the out-dated system of social and medical care of the past.

The second paper was read by Miss S. R. Burstein, of the Wellcome Historical Medical Museum, who urged that the problems of many old people are essentially mental rather than matters of physical infirmity or disease. The problems of adolescence have been the subject of a great deal of careful psychological and social research; there is a need for similar research upon the emotional problems concerned with the transition from middle to old age and especially upon the ways in which the years of old age can be used. It should be recognized that old age is not something which comes suddenly—ageing is continuous from birth—and that it is fundamentally wrong to segregate old people as 'problem cases' away from the functioning life of the community.

Miss Burstein stressed that one of the difficulties for those doing research upon problems of old age is that they are usually younger, and that it is thus difficult for them to understand fully the outlook of the people with whom their research is concerned. She urged that discussion with old people individually or in small groups, if done with patience and respect, yields far more insight into their attitudes and needs than can methods such as questionnaire studies which are more immediately convenient to the research worker.

The traditional pattern in which the whole family, old and young, lived together under one roof has largely broken down, with the result that many old people are extremely lonely. A return to the traditional pattern is clearly impossible, and, even if it were, it might involve satisfying the needs of old people at an undue cost in terms of freedom and privacy for those younger. Intermediate solutions where, for example, old people live alone but close to younger relatives often work well. The point needs to be stressed, said Miss Burstein, that old people themselves must carry a large share of the responsibility for making such arrangements successful. Although they are often glad of the opportunity of leisure afforded by retirement, many of them are capable of useful work, and this applies not only to work at a job but also to help in the family as a functioning group.

Mrs. A. V. Hill, a member of the Advisory Council of the National Corporation for the Care of Old People, read the third paper, which was an account of some emotional changes observed in advanced old age—mainly between eighty and a hundred years. Although these emotional changes may accompany physical changes, the emotional needs of old people cannot be met by physical care alone. Little study has been made of old people's needs, and physical care without attention to emotional needs often constitutes actual cruelty. While certain main lines of emotional change can be observed, it should be emphasized that, on one hand, striking exceptions occur among very old people and that, on the other, changes can take place before any great old age in terms of years alone has been attained.

The behaviour of very old people can often be explained in terms of fear of death, or of illness or of change of environment. The will to live is as strong as ever, and fear of illness or accident may dominate the life of an old person. At the same time they may unconsciously feign illness in order to gain attention. Movement from one dwelling to another frequently produces a 'transference shock' with signs of mental and physical deterioration which can sometimes result in death. Usually, however, old people settle down in the new dwelling, although they may take some weeks to do so. This has been frequently noticed among new residents in old people's homes, and, when it seems likely to occur, the old people are persuaded not to cut adrift completely from their old haunts until they have come to know the new. Among other emotional attitudes, affection, friendship and concern for the opinions of others suffer a marked reduction. In the extreme, apathy and general indifference may appear, especially after long periods in bed. Interest

in what immediately concerns oneself may increase: thus small treasures are hoarded, and interest in food may grow. At the same time, the gift of being able to "enjoy other people" often continues to the end of a very long life.

Mrs. Hill urged that, broadly speaking, bed is bad for old people unless absolutely necessary on account of severe illness or weakness. Where possible, old people should be provided with small convenient dwellings where they can live alone. The independence and the effort involved in living alone can, as an example in one housing trust has shown, help old people to remain young for their age. Old people's clubs can help to relieve any loneliness which may be involved, and so also can part-time employment. An important experiment in the employment of people between seventy and eighty years of age for two hours daily is being made in Finsbury.

It is to be emphasized that people do not "suffer from old age": they suffer from illness, unhappiness and loneliness, but not from old age as such. There seems to be an increasing tendency to resist and resent old age. Those old people who accept and understand its inevitability are emotionally in a much stronger position than others.

Dr. John A. Oliver, principal officer in the Ministry of Health and Local Government, Northern Ireland, read an address entitled "Thinking About Old Age", in which he gave an account of present-day social problems of the elderly, with some reflexions on social thought and social policy. He outlined the main features of the social problems of old age to-day—more people surviving into old age in a community distressed by a housing shortage and a dearth of domestic help; and a weakening sense of family responsibility towards their elderly relatives on the part of parents anxious to give their children the best possible chance in difficult circumstances. This decline in family responsibility is encouraged, perhaps, by the lack of any legal obligation to provide for elderly relatives and by the increasing State provision being made for them. Dr. Oliver considered that the progress in social work and social legislation made in the last ten years has been largely pragmatic and has been "achieved without any real preparation in fundamental thinking". The practical workers beset by immediate problems have tackled them empirically as they arose, and our new social legislation, as it applies to the problems of ageing, has been launched in a philosophical vacuum. A philosophy of the social work, the social policy and the social services which we are operating must be evolved from experience and thought. Both legal and moral duties are involved in family responsibility for the aged, and we must recognize the fact that the State cannot be committed to an unlimited liability for the care of old people. Moreover, the hopes and desires of the old people themselves must be considered; and, since home is the normal place for most of them to live and end their days in, social services designed to make it easier to look after elderly relatives at home should be augmented and their potential contribution to industry encouraged by suitable work under suitable conditions. Is progress henceforward to depend on individual enterprise, asked Dr. Oliver—"the effort of the old person, the effort of the relatives and the neighbours or on community services devised by the State"? He said that he believes that this choice between individualism and collectivism is the central philosophical problem in the so-called Welfare State. In conclusion, he suggested that the British Association might establish a new section devoted to social science, or social philosophy, so that "British science may demonstrate its concern for social well-being and spiritual values".

Mr. A. T. Welford, director of the Nuffield Research Unit into Problems of Ageing, spoke of changes of human performance with age which affect capacity for industrial work. He stressed that many such changes associated with old age begin early in middle age, so that problems of employment for older people are not concerned only with those over the normal retiring-age. At some jobs ability seems to be well maintained into old age, and for almost all jobs a few older people can be found who are able to put up a performance comparable with that of a young man. At other jobs difficulties of maintaining adequate performance appear as early as the late forties. Difficulties of taking up a new job may appear earlier still.

The main difficulties for older people appear to be of three types, the first being where the form or the pace of the action involved is rigidly determined so that any slowness leads to an error of omission which cannot be afterwards redeemed. When the task is more flexible and the speed under the operator's control, an older person is often capable of compensating for slowness by increased care and accuracy. As a result of these compensatory tendencies, difficulties for people in later middle age in industrial work may go undetected—people maintain performance under an increasing strain until a suitable opportunity occurs to move away. Such moves are sometimes made following an illness which would not in itself warrant a change of job. Detailed examination of performance shows that often, contrary to popular opinion, slowness even in a manipulative task is due not to any limit set by the sense organs or by the effectors, but by the central brain processes which integrate and interpret information and form action.

The second type of difficulty occurs where the task is in some way complicated or confusing. So long as the relation between signals and the action required in response to them is simple and straightforward, performance by older people differs relatively little from that of younger. When, however, the relation is indirect or where several pieces of information have to be put together before action is taken, many older people are at a severe disadvantage.

The third type of difficulty is that of learning new tasks. This is, of course, generally recognized. The nature of the difficulty is not, however, clear. To some extent it is due to the application to the new task of previous habits which are not appropriate. In some cases, however, it appears to be due to inability to modify an erroneous method built up during early stages of practice.

In studying changes of performance with age, concluded Mr. Welford, it is important that we should not be led astray either by generalizations or by particular exceptional individuals. The ability of older people to do a job will depend both on the detailed demands of the job and upon the particular abilities which each individual can bring to it. Rigid general policies about retirement cannot therefore be justified on grounds of ability. The appropriate retirement-age will differ for the majority from one job to another, and from one individual to another at any job.

G. F. Adams
A. T. Welford

CARNEGIE INSTITUTION OF WASHINGTON

ANNUAL REPORT FOR 1951–52

THE report of the president of the Carnegie Institution of Washington, Dr. Vannevar Bush, for the year ending June 30, 1952*, reviews the progress of the Institution during the fifty years since its foundation and then briefly summarizes the research activities of the past year. The aim prescribed for the Institution was to "encourage, in the broadest and most liberal manner, investigation, research and discovery, and the application of knowledge to the improvement of mankind". In furtherance of this aim, the Institution has always devoted its main resources to fundamental research, which Dr. Bush distinguishes from applied research in terms of purpose rather than of method, and it has no thought of changing its policy. While he welcomes the growing realization in the United States that basic and applied science are two parts of one endeavour, and the consequent expansion of fundamental research with increased support from the Government, Dr. Bush believes that the Institution's primary responsibility remains to carry on fundamental scientific research with no initial view to its industrial application. Where, however, in its fundamental research, ideas and principles emerge that promise material advantage to society, it is proper for the Institution to explore some of the broader possibilities of application for human betterment.

In the main, the Institution has fulfilled its duty, in Dr. Bush's view, if it is diligent in making the results of its work generally known as promptly as possible. This preoccupation with fundamental research has simplified many of the Institution's problems and its relations with other bodies, as it has determined the policy in regard to patentable inventions which Dr. Bush outlines in some detail. He does not consider, however, that the absence in the United States of any effective organization for bringing the fruits of disinterested research to the point where they invite industrial development warrants the Institution plunging into the application of science. The Institution may sometimes, nevertheless, need to look ahead beyond its immediate programme of research and publication.

Dr. Bush justifies this policy by citing the part which the Institution has played, in collaboration with the National Research Corporation and the Stamford Research Institution, in exploring the practical aspects of the mass cultivation of algæ following the investigations on photosynthesis in its Department of Plant Biology which demonstrated the possibility of growing the green alga *Chlorella* so as to produce 56 per cent dry weight of protein. Other instances are also cited in the report of researches which have been conducted by the Institution during the past half-century so as to contribute to an understanding of the cosmos, the earth and its inhabitants, and which have later provided the basis of important developments or practical undertakings. They include early work in 1925 on pulsations and their echoes from the ionosphere, which was one of the pioneer researches in radar, investigations in the Geophysical Laboratory on low-expansion quartz glass, which led to the development of 'Pyrex' and similar glasses, and the basic study of the soda-lime–silica system in the same Laboratory, which contributed to a scientific understanding of the glass industry. Later, a modified formula for annealing 'Pyrex' glass in large castings was fundamental to the successful manufacture of the 200-in. 'Pyrex' mirror for the Hale telescope, and the Laboratory studies of the ternary system lime–alumina–silica contributed to the development of the Portland cement industry. The researches of the Department of Embryology form an important part in every text-book on human embryology published during the past decade, and the Soil Conservation Service of the United States Department of Agriculture has drawn extensively on the basic knowledge of the evolution of new plant species gained in the range-grass experiments of the Department of Plant Biology during the past decade.

Turning to current research activities, the report refers to the co-operation between, on one hand, W. Baade and R. L. Minkowski, of the Mount Wilson and Palomar Observatories, and, on the other, groups of radio observers in Australia and England which has led to the identification of the strongest radio source, Cassiopœia *A*, with a galactic emission nebula about five minutes of arc in diameter, and of the second strongest source, Cygnus *A*, with an extra-galactic nebula the structural pattern of which Baade interprets as probably representing two nebulæ in collision. A twelfth satellite of Jupiter was discovered by S. B. Nicholson on September 28, 1951. Investigations by E. H. Vertine, of the Department of Terrestrial Magnetism, afford an explanation of the major changes in the rate of the earth's rotation during the past fifty years, while, under a joint project with the Geophysical Laboratory, methods have been worked out for measuring the ages of virgin granite and of unaltered rocks found in close association with such massive igneous monoliths as, for example, the Sierra Nevada range. New methods and apparatus developed by the latter Laboratory have permitted rapid and easy measurements at pressures up to four thousand atmospheres and concomitant temperatures up to 800° C.

The Department of Plant Biology has continued its studies of the alga *Chlorella*, including the rate of photosynthesis with intermittent light over new ranges of intensities and flashing schedules, while urea has been found to be an excellent source of nitrogen for the growth of algæ. Some four hundred new hybrids have been produced between different species of blue grass, and a basic study of the genetic and ecological systems that characterize natural races and species is being advanced using the milfoils or yarrows. In the Department of Genetics investigations on mutability in *Escherichia coli* indicate that the rate of spontaneous mutation varies with temperature according to the van t'Hoff rule, and that an intimate relation exists between spontaneous mutation and cell division. It has been established that a typical bacterial virus consists of a membrane (chiefly protein) containing almost pure nucleic acid and that the function of the viral membrane in the infection of the bacterial cell begins with the anchoring of the viral particle to the cell wall and quickly ends with the injection of the viral nucleic acid into the cell. An enzyme capable of breaking down isolated, but not intact, intracellular deoxyribonucleic acid has been discovered in onion root tips, and studies on maize have indicated that at least two classes of functional genetic unit are carried by the chromo-

* Report of the President of the Carnegie Institution of Washington for the Year ending June 30, 1952. By Dr. Vannevar Bush. Pp. 20. (Washington, D.C.: Carnegie Institution, 1952.)

somes: one of them, the gene, is potentially capable of determining a particular course of cellular reactions; the other is associated with the control of this particular action.

In the Department of Embryology the discovery that there is extensive formation of neural-crest cells by the early embryonic eye (optic vesicle) throws light on the origin of the pigmented cells which appear early in the development of the eye. The development of the earliest human kidney rudiments has been thoroughly re-investigated, and further investigation of the physiology and biochemistry of uterine muscle has demonstrated that the 'staircase phenomenon', long known in heart muscle, occurs also in uterine muscle, and that the slope of the staircase is reversed by treatment with the corpus luteum hormone, progesterone. The discovery points to an essential role of potassium ions in uterine muscle contraction, and suggests that progesterone can modify the movement of potassium in and out of the muscle cell.

OPTICAL SOCIETY OF AMERICA

ANNUAL MEETING IN BOSTON

THE thirty-seventh annual meeting of the Optical Society of America was held during October 9–11, 1952, at Boston, Mass. Twenty-two invited papers covering spectroscopy, computational aids and atmospheric effects, in addition to other fields of science bordering on optics, were presented. The titles and abstracts of these papers and of the other contributed papers, together with a brief report of the proceedings of the meeting, are printed in the November issue of the Society's *Journal* (42, 868; 1952).

The invited papers include a discussion by N. Wiener on optics and the nature of spectra, a review of hyperfine structure investigations by F. Bitter, and a description of germanium phototransistors by J. N. Shive, of the Bell Telephone Laboratories. Various aspects of spectroscopy and radio astronomy are covered by communications from G. H. Harrison, R. Tousey, E. M. Purcell and others, including, in particular, one on multi-channel spectrometry by F. B. Fellgett, of the University Observatories, Cambridge. In addition, a review of recent developments in infra-red spectroscopy is given by R. C. Lord.

Three papers are devoted to the subject of "Flying Saucers". It is pointed out by D. H. Menzel, of the Harvard College Observatory, that about one-fifth of the numerous reports received by the United States Air Forces did not admit of a simple explanation but that the majority of these, when examined carefully, could be explained as due to atmospheric physical phenomena, such as mirages, or reflexions from layers of fog or haze, or from ice-crystals. From a study of several hundred reports of unidentified aerial objects, it is concluded by A. Hynek, of the Ohio State University, that only one phenomenon, that of a hovering nocturnal light, is not readily explicable on an astronomical basis, and, finally, it is definitely stated by U. Liddel, of the Bendix Aviation Corporation, that no evidence exists for any phenomena not explicable by standard physical concepts.

The annual business meeting of the Society was held on the morning of October 10, and the annual banquet, preceded by a cocktail party given by the American Optical Company, during the evening. At the banquet, over which the Society's president, Brian O'Brien, presided, the Adolph Lomb Medal was presented to Dr. A. B. Meinel, of the Yerkes Observatory, and the Frederic Ives Medal to Dr. Ira S. Bowen, director of the Mount Wilson and Palomar Observatories. The after-dinner speaker was Dr. Harlow Shapley, of the Harvard College Observatory, who spoke on the subject of galaxies. The Adolph Lomb Medal is awarded to a promising scientist under thirty years of age, and the Frederic Ives Medal, which was established in 1928 by Herbert Ives in honour of his father, is for distinguished work in optics. Both medals are awarded every two years.

On receiving his medal, Dr. Bowen gave an address, entitled "Optical Problems at the Palomar Observatory", in which he described the support systems and the testing of the mirror and methods of increasing the effectiveness of the 200-in. Hale telescope, the main instrument at the Observatory. The mirror is a paraboloid of 660 in. focus; but, in addition, convex hyperboloids are provided which, when combined with the main mirror, give telephoto systems of which the focal lengths are 3,200 in. at the Cassegrain focus and 6,000 in. at the coudé focus. In addition to the mirror, the equipment of the Observatory includes three Schmidt cameras of 8, 18 and 48 in. apertures and operating at focal ratios of 1, 2 and 2·5, respectively. Dr. Bowen remarked that the cameras have remarkably fine definition over fields 9–20° in diameter and are efficient instruments for the rapid photography of large areas of the sky. Nearly all the equipment described has been in operation for from six months to three years, and the performance has come well up to expectation.

BRITISH ASSOCIATION OF CHEMISTS

HINCHLEY HOUSE

THE British Association of Chemists has recently acquired a freehold property, 14 Harley Street, London, W.1, for use as its headquarters. It was decided to name the premises 'Hinchley House' in memory of Prof. J. W. Hinchley, a founder member and the first president (1918–23). It was due to his influence and skill in directing its policy that the Association survived its first four difficult years. Prof. Hinchley was also instrumental in founding the Institution of Chemical Engineers, and his name will always be associated with chemical engineering, for many of the advances it has made in Great Britain are due to his conviction of its importance to industry and the necessity of making it a specialized branch of scientific study. The name of Prof. Hinchley had earlier been perpetuated through the annual award of the Association's Hinchley Medal, which is given for outstanding services to the profession of chemistry.

An opening ceremony was held at the new headquarters on February 27, when a number of members and guests, representing other bodies connected with the profession of chemistry, were present. Mr. F. Scholefield, president of the Association, in declaring the premises open, said that this function was indeed a red-letter day in the history of the British Association of Chemists, which thus became the first society of chemists to possess its own freehold property in London. The Association was formed in 1917 owing

to the strong feeling among chemists in industry that there was no body having the prime function of looking after the economic interests of chemists. The Institute of Chemistry, as it was in those days, was a qualifying body, and it was outside its scope to look after such interests. After meetings in Birmingham, Manchester and London, the Association was formed.

Before long there was established, on the initiative of the London Section, a scheme whereby unemployment benefit was made available to members. The Unemployment Benefit Fund has been so well managed that to-day it is possible for the Association to pay as much as nine guineas per week to members temporarily unemployed. Although more than £20,000 has been paid out in benefit, there is to-day a balance of £52,000. It appeared to the House Committee, which included Mr. Norman Sheldon (chairman), Mr. C. S. Garland, Mr. G. T. Gurr and Mr. H. L. Howard, that it would be possible to invest some of that money to the advantage of the Fund and at the same time provide a worthy headquarters for the Association. Mr. Scholefield said that the greatest credit should be given to the House Committee, and that he would like to congratulate those who have been responsible for this really magnificent result. He then declared Hinchley House to be open.

After the ceremony, a tablet, inscribed with the names of the past-presidents and Hinchley medallists, was unveiled by Dr. Herbert Levinstein, who was president of the Association during 1923–24, immediately after Prof. Hinchley. This tablet was presented in memory of the late Mr. C. A. Wylie, president during 1951–52, by his family and friends.

Afterwards Dr. Levinstein gave this year's Hinchley Medal address entitled "Our Changing Chemical Industries: an Appraisement".

SURVEY OF FOOD CONSUMPTION AND EXPENDITURE IN GREAT BRITAIN

In Great Britain the War-Time Food Survey was almost entirely limited to urban working-class households, and, as the National Food Survey, it continued in the same form until the end of 1949. Since then, however, an attempt has been made to obtain a more representative sample, so that all classes and types of consumer are included. A recent report issued by the Ministry of Food* is the first of an envisaged annual series, setting out full details of food consumption and expenditure by families throughout the country.

Records were obtained from 4,723 families, of which 70 per cent were "urban working class", 11 per cent were "other urban households", and 19 per cent were "rural". The first group provides data suitable for direct comparison with results obtained in the earlier surveys and permits long-term trends to be followed through. The new material, however, is subjected to much more detailed analysis in an attempt to bring out economic, dietetic or nutritional differences between one group and another. Families are divided according to "composition" and to "social class", and numerous tables are presented which show the effects of increasing numbers of children in the household. Seasonal variations are demonstrated, and also the varying ability of the different social groups to maintain their normal standards in the face of price increases (temporary or progressive).

As a social document this report is probably as valuable as any; the data on which it is based are considerable and there is every sign of the greatest care having been taken to obtain a high degree of accuracy at every stage. Yet, as a contribution to nutritional knowledge in Great Britain it is disappointing; it does not establish the caloric and nutrient levels at which these families were actually living, and yet that is the information which would be of most value.

The factual material, on the food consumption side, is confined to the amounts bought or obtained "free" during the survey week, together with appropriate additions or deductions according to "changes in stocks". The amounts discarded by the housewife in preparing the food for table have not been measured, nor has any record been made of the amount of edible material that was not actually eaten. It is a great weakness in this type of survey that, on both scores, arbitrary adjustments have to be made. The allowance for wastage of edible material made here is an overall ten per cent; but do we really throw away one loaf in every ten, every tenth bottle of milk, one-tenth of our butter, our sugar and all the other foodstuffs of which so many communities stand in the direst need? If we do, it is time that the crime of so doing was brought home to us more strongly. It is good that a footnote promises that this matter is to be examined further; certainly, it seems unlikely that all foods are wasted in the same proportion and to the same extent by all social groups.

Despite these deductions, however, it appears that intakes were more than adequate in practically all respects, although households with four or more children, or with both adolescents and children, were only marginal and were adversely affected by the lowering of the extraction rate of flour from 85 to 80 per cent in the middle of the year. There is, however, ample room for further errors in the estimates of requirements and in the arbitrary deductions made from the standards used, to allow for meals obtained outside the home. It is to be hoped that modifications will be introduced into the survey technique so that the necessary adjustments may, in future, be made on a more factual basis.

M. W. Grant

* Ministry of Food. Domestic Food Consumption and Expenditure, 1950, with a supplement on Food Expenditure by Urban Working-Class Households 1940–1949. Annual Report of the National Food Survey Committee. Pp. 132. (London: H.M.S.O., 1952.) 4s. 6d. net.

WINTER CASCADING FROM AN OCEANIC ISLAND AND ITS BIOLOGICAL IMPLICATIONS

By BRIAN P. BODEN and ELIZABETH M. KAMPA

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The circulation of Bermuda waters during the summer, and the possibility that this circulation acts as a mechanism for conserving insular plankton, have already been discussed[1]. Since that discussion presented only the summer picture, it became of interest to determine the winter circulation in order to understand the existence of an endemic plankton population.

It must be emphasized again that the marginal reefs around Bermuda are not at all continuous;

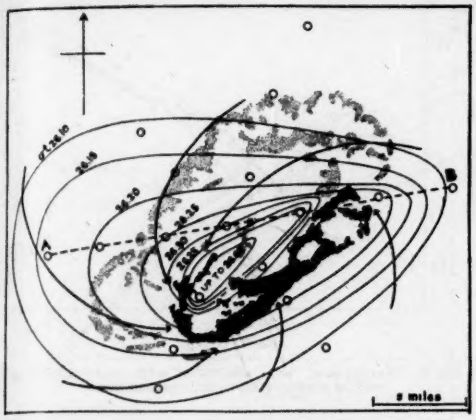

Fig. 1. Map of Bermuda and station plan. The islands are represented in solid black and the reefs are stippled. The stations are indicated by small circles. The intersections of σ_t surfaces with the sea-surface are shown. The direction of the arrows is the probable direction of the water-movement. The section *AB* is shown in vertical profile in Fig. 2

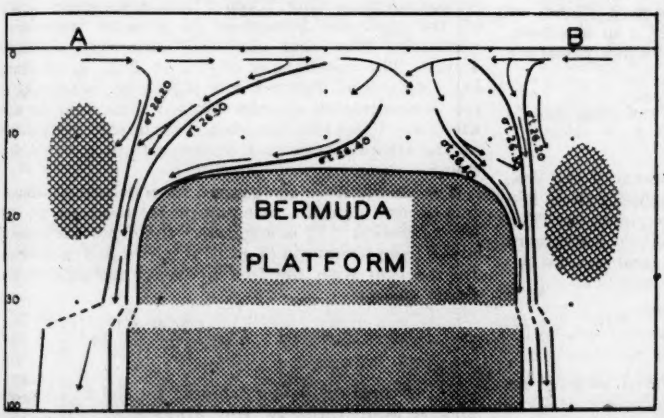

Fig. 2. Vertical density structure through section marked *AB* in Fig. 1. σ_t-Surfaces are shown and probable direction of flow is indicated by arrows. The cross-hatched areas represent density inversions in the water-column

they present no real barrier to free exchange between the lagoon and oceanic waters.

During a winter cruise, nineteen radially arranged hydrographic stations were occupied around the island and in the lagoon. Ekman reversing bottles and Negretti and Zambra reversing thermometers were used for obtaining water samples and temperatures at standard depths from the surface to 100 m. or to the bottom. Bathythermograms were made with both shallow and deep bathythermographs. The weather in Bermuda in late February frequently makes oceanographic work from a small, open boat rather hazardous, and for this reason it was considered desirable to complete as many stations as possible in as short a time as possible. Plankton sampling was therefore eliminated, making it possible to occupy enough stations to determine the hydrographic conditions.

The average surface salinity in the lagoon was 36·48 ‰, and at the oceanic stations it was 36·45 ‰. Surface temperatures in the lagoon averaged 18·60° C., while outside the lagoon the average was 19·11° C.

The intersections of σ_t surfaces (equal density at zero pressure) with the surface of the sea are shown in Fig. 1. This density distribution must be associated with a cyclonic vortex. Both thermal and haline circulations exist and reinforce each other.

The vertical distribution of density along the section marked *AB* in Fig. 1 is shown in Fig. 2. The probable direction of water movement is indicated by the arrows. The surface water flows into the lagoon where (its specific gravity increased by cooling) it sinks and flows out along the lagoon floor and down the sides of the island. The cross-hatched areas at the edge of the platform represent density inversions in the water column, the water in the cross-hatched areas being heavier (by 0·02 σ_t-unit) than the water above it or immediately below it. This anomaly exists all around the island, probably because the momentum of the heavy water flowing over the edge of the platform is sufficient to carry some of it over the lighter water to the cross-hatched areas where mixing takes place. This vertical circulation is the type of local cascading over shallow banks discussed by Cooper and Vaux[2].

In general, then, the winter circulation can be described as a cyclonic, convergent movement about a sinking centre (as indicated by the arrows in both figures), and a certain amount of vertical mixing across the σ_t surfaces takes place. This convergent movement and general cyclonic drift during winter are a complete reversal of the summer circulation, and have been noted in early Bermuda Biological Station reports (unpublished) as a result of drift-bottle surveys and of the inshore presence of oceanic plankton forms. In common with the summer circulation discussed previously, this circulation may be typical of the majority of islands in temperate latitudes.

The summer circulation about Bermuda has been shown to favour the survival of an endemic plankton population and of a benthos with planktonic larval stages[1]. With the exception of those forms which have dormant winter stages, enabling them to survive in local pockets until the return of favourable summer conditions, such an endemic insular plankton could not persist through an adverse winter circulation. The vertical circulation discussed here certainly does tend to carry the plankton down, probably to considerable depths, where it may be carried away from the island by the large-scale currents flowing past it. Singularly enough, the more feeble swimmers such as the larger medusæ, the powers of vertical migration of which are limited, do not appear in the plankton until the summer. The shallower summer circulation, which concentrates them around the island, tends to keep them also in the upper layers. This is doubly favourable, for most of these medusæ carry symbiotic algæ which would perish at depth.

The greater part of the zooplankton, however, migrates to the surface at some time during the day or night. It is thus returned to waters which are converging upon the island. [Aug. 11.

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RESONANCE RADIATION FROM HYDROGEN FLAMES CONTAINING ALKALI METALS

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PREVIOUS workers[1,2] have shown that the intensity of the resonance radiation emitted by alkali metal atoms in flames (transition $nP_{3/2,1/2} \rightarrow nS_{1/2}$) varies linearly with concentration for small amounts, and with the square root of the concentration for large amounts, of the metal. This change of order depends on the self-absorption in the flame, which is in turn a function of the broadening of the lines by Doppler and collision effects. The present work demonstrates how these considerations may be applied to the problem of the formation of stable gaseous hydroxides in flame gases, and further to the elucidation of the collision diameters of the excited alkali atoms, using the results at low and at high concentrations respectively.

On the basis of the treatment of Mitchell and Zemansky[1], it can be shown that the measured intensity I of the light emitted from a flame, of thickness l cm. and temperature $T°$ C., in the form of resonance radiation from an added alkali metal is:

$$I = \frac{8\pi\alpha hc}{\lambda^3} \cdot \left(\exp-\frac{hc}{\lambda kT}\right) \int_0^\infty \{1 - (\exp - k_\nu l)\} d\nu, \quad (1)$$

where λ is the wave-length of the centre of the line, and the integration is performed over the whole line with absorption coefficient k_ν at frequency ν. The constant α depends on the measuring instrument only. At low concentrations the integral reduces to:

$$l \int_0^\infty k_\nu d\nu = \frac{\lambda^2}{8\pi} \cdot \frac{g_2}{g_1} \cdot \frac{Nl}{\tau} \equiv \frac{\pi e^2}{mc} \cdot Nfl, \quad (2)$$

where τ is the mean life of an excited atom, f the 'f value' of the transition, N the number/c.c. of alkali atoms in the ground state, and g_2 and g_1 the statistical weights of excited and ground states respectively.

Introducing the total absorption A_G, defined by Ladenburg and Reiche[3]:

$$A_G = 2\pi \int_0^\infty \{1 - (\exp - k_\nu l)\} d\nu, \quad (3)$$

equations (1) and (2) give rise to:

$$\frac{A_G}{\Delta\nu_D} = \frac{2\pi^2 e^2}{mc} \cdot \frac{Nfl}{\Delta\nu_D}, \quad (4)$$

where $\Delta\nu_D$, the Doppler broadening, has been introduced for reasons seen later. Plots of log $(A_G/\Delta\nu_D)$ against log $(Nfl/\Delta\nu_D)$ for the various metals should therefore coincide at low concentrations, and have unit slope.

Measurements of I and hence A_G have been made by adding fine sprays of alkali metal salts of known strength from an atomizer to the air-supply of a pre-mixed hydrogen/air flame, burned in a Mèker-type burner with a surrounding flame of similar composition but without spray, so as to give a shield against self-reversal at the boundary, and observing the light emitted about 1 cm. above the small cones with a photocell. The light was chopped by a sector disk, which synchronized an amplifier so as to enhance selectively the photoelectric signal. Lines were isolated by Ilford spectrum filters and a dilute copper sulphate filter. Apart from a constant factor α', the measured intensities on a meter were converted by filter and photocell factors to absolute values. The results are shown in Fig. 1, plotting log $(A_G/\alpha'\Delta\nu_D)$ against log $(Cfl/\Delta\nu_D)$, where C is the concentration of salt solution (chloride) in the atomizer. Complete dissociation of the salt is expected at the temperatures and concentrations used in the flame.

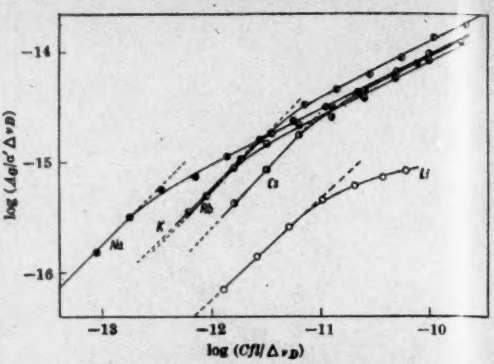

Fig. 1. Variation of 'total absorption' with concentration for various alkali metals in hydrogen/air flames

The results have the general form described above, but do not coincide, as equation (4) requires, at low concentration. It is suggested that this divergence arises from formation of gaseous hydroxide molecules, by reaction with the free hydroxyl radicals of the flame gases:

$$AOH \rightleftharpoons A + OH\,; \quad K = \frac{[A]\,[OH]}{[AOH]} \equiv \frac{[OH]}{\varphi}. \quad (5)$$

[OH] is constant, being buffered by the flame gases, and is approximately 10^{-3} atmospheres, while the alkali metal concentration is in the range 10^{-4}–10^{-1} atmospheres. These results support previous work by Smith and Sugden[4] on ionization in flames and on the theoretical values of the equilibrium constant K of equation (5): in particular, that work suggested that gaseous NaOH was negligible in these flames, but that the relative stability of the other hydroxides was LiOH > CsOH > RbOH > KOH, corresponding with the conclusion which may be drawn from Fig. 1, namely, that the concentration C is not a measure of N, but of $(1 + \varphi)N$, and that this factor $(1 + \varphi)$ is responsible for the non-coincidence of the lower portions of the plots of Fig. 1. The values of φ derived from Fig. 1 are somewhat higher than those from the ionization work.

If this hypothesis be correct, then the relative corrections from C to N may be made by shifting the curves along the abscissæ so that the dilute portions coincide with that of the sodium (since its hydroxide may be neglected). The remaining (square-root) portions of the curves may now be compared.

The general expression for the absorption coefficient k_ν is very complicated, but we have shown that the following simple form is valid in the square-root portions of our plots:

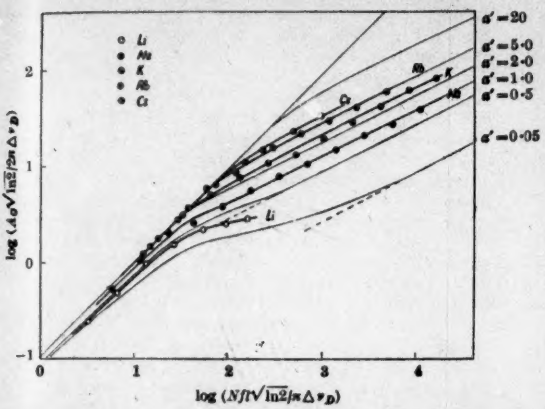

Fig. 2. Plots of 'total absorption' for determination of collision diameters

$$k_\nu = k_0\left(\frac{a'}{\omega^2\sqrt{\pi}}\right), \qquad (6)$$

where $\omega = \dfrac{2(\nu-\nu_0)\sqrt{\ln 2}}{\Delta\nu_D}$, $a' = \dfrac{\Delta\nu_N + \Delta\nu_L}{\Delta\nu_D}\sqrt{\ln 2}$

and $$k_0 = \frac{2}{\Delta\nu_D}\sqrt{\frac{\ln 2}{\pi}}\cdot\frac{\pi e^2}{mc}\cdot Nf,$$

in which $$\Delta\nu_D = \frac{2}{\lambda}\sqrt{\frac{2RT\ln 2}{M_1}},$$

ν_0 is the frequency of the centre of the line, $\Delta\nu_N$ is the (negligible) natural broadening and $\Delta\nu_L$ the Lorentz collisional broadening

$$\left(=\frac{2}{\pi}\sigma_L^2 N_2\sqrt{2\pi RT\left(\frac{1}{M_1}+\frac{1}{M_2}\right)}\right),$$

where M_1 is the atomic weight of the alkali metal, M_2 the molecular weight of the colliding species of population N_2/c.c., and σ_L the collisional diameter of the excited alkali atom in the flame. This leads to equation (7):

$$\frac{A_0}{\Delta\nu_D} = 2\pi\sqrt{\frac{2\pi e^2}{mc\sqrt{\ln 2}}}\cdot\sqrt{a'}\cdot\sqrt{\frac{Nfl}{\Delta\nu_D}}, \qquad (7)$$

with expected variation with $\sqrt{N}$. The family of curves of $\log(A_0/\Delta\nu_D)$ against $\log\left(\dfrac{Nfl}{\Delta\nu_D}\cdot\dfrac{\sqrt{\ln 2}}{\pi}\right)$ with various a', as depicted by van der Held[4], will be absolute. The theoretical forms for various a' are shown in Fig. 2 (thin lines). To accord fairly closely with the recent work of Sobolev, Mezhericher and Rodin[3], and the results of Schütz[6], the experimental curve of Fig. 1 for sodium has been superposed on $a' = 1{\cdot}0$, and the hydroxide correction above made to bring the others into their correct relative positions (thick lines with points).

The ordinates of the square-root parts give values of a' from which the collision diameter σ_L can be deduced, assuming the colliding species to be mainly nitrogen. These are given in the table.

Metal	a'	$\sigma_L^2 \times 10^{16}$ cm.^{2}
Lithium	0·3	22
Sodium	1·0	68
Potassium	2·8	125
Rubidium	5·3	180
Cæsium	6·3	164

The last column is of the expected order, with the exception of cæsium, which is rather anomalous. Further support is given by the results for lithium, which are beginning to show the characteristic flattening of very low a' in Fig. 2.

Since van der Held's curves are absolute, these results can be used to give the absolute concentration N in the flame. Thus 1N sodium solution in this case gives, from Figs. 1 and 2, $2{\cdot}3 \times 10^{14}$ atoms/c.c. of flame, in the ground-state, corresponding with a partial pressure of 7×10^{-6} atmosphere.

This type of study can provide, therefore, information which is useful in practical flame photometry, in measuring concentrations and therefore in studying equilibria at high temperatures, and in the study of collisional phenomena connected with radiation. [July 28.

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STRUCTURE OF STARCH

By Prof. R. H. HOPKINS

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In a recent communication, Blom and Schwarz[1] conclude that the molecules of starch contain, in addition to the generally accepted α-1,4- and α-1,6-glucopyranosidic linkages, an additional type of glucosidic link. The type which is considered by them to fit the facts is the α-1,5-link connecting a glucopyranose to a glucofuranose residue, this occurring alternately with the 1,4-link. In other words, the part of starch which is susceptible to the action of β-amylase is composed of unbranched chains consisting of alternate pyranose and furanose rings. The authors do not develop their hypothesis, but merely indicate how, under it, β-amylase would function. The experimental evidence furnished is, briefly, that on hydrolysis by acids the fall in optical rotation is abnormally small in the first stages of fission, rising considerably as the reaction proceeds. The existence of an additional type of link is indicated, and this leads straight to the above conclusion. A re-examination of the evidence for the accepted structure is called for, attention being confined to the unbranched part of starch, for example, amylose.

The hypothesis of alternate pyranose and furanose links has its attractions for the enzyme chemist. For example, the action of β-amylase, which, starting from the non-reducing end of a chain, by-passes the first link but breaks the second one although this is identical with the first one, and produces β-maltose from an α-link, presents features which are unusual in enzyme action. On their hypothesis, although the authors do not state so, it is necessary to assume that

the first two glucose residues from the non-reducing end are in the pyranose form linked as in maltose, and that a 1,5-link to furanose follows. We may assume that hydrolysis by enzymes proceeds by such mechanism as this:

β-Amylase breaks the 1,5-link liberating α-maltose. It must be presumed also to open the furanose ring of the adjoining group, leaving it in an open-chain form, from which a new pyranose ring is formed, thus accounting for the mutarotation in the upward sense. The estimated rise in rotation would be about sufficient to mask the downward change in the liberated α-maltose and leave a resultant upward change equivalent to that observed by Kuhn[2]. Two pyranose residues are now at the end of the chain in position for the next fission by the enzyme.

α-Amylase splits 1,5-links at various parts of the chain, similarly opening the adjoining furanose residue but catalysing also its closure to the pyranose ring. This enzyme must be assumed to combine functions of fission with those of the 'mutarotase' recently described[3] which catalyses mutarotation of glucose. Indeed, the opening of the furanose ring might facilitate the accompanying fission at its fifth carbon atom. Thus α-amylase splits off α-mutarotating fission products; the upward mutarotation due to the furanose–pyranose change is not observed, it being as rapid as the enzyme action.

Hydrogen ions function to the same effect as α-amylase, attacking the 1,5-links much more readily than the 1,4-links. The high (for example, 80 per cent) yield of acetobromomaltose from starch by the action of acetyl bromide[4] would require the same mechanism for the hydrolysis.

Calculation of the specific rotatory power of starch (in water) on the basis of that of the α-glucosidic link and residue in maltose leads to higher values[5], + 229°, than those observed (200°). On the hypothesis put forward, it would approximate to the latter.

The adverse side of the picture must be presented. Including the usual arguments[6,7] in favour of the α-glucopyranoside chain there are the following:

(1) Furanose forms are rare in naturally occurring glucose compounds.

(2) The rates of hydrolysis of furanosides by acids, for example, ethyl glucofuranosides, are some 50–200 times faster[8] than those of the corresponding pyranosides. To answer this it would be necessary to assume that the furanoside group in the middle of a chain, with its fifth carbon atom anchored to the chain beyond, could be quite stable; and, in fact, that its 1,4-glucosidic link is not attacked by the hydrogen ion as readily as the pyranosidic 1,5-link, while the latter in its turn is hydrolysed more slowly than the link in maltose[5,6]. But the exposure of a furanose residue by fission of the 1,5-link adjoining it should leave it susceptible to rapid acid hydrolysis, as with the ethyl glucofuranosides, so that each 1,5-fission should be, in effect, accompanied by an α-1,4-fission. The latter would cause such a fall in optical rotation as to mask the small fall caused by the 1,5-fission, and no maltose would be formed. Blom and Schwarz do not consider that such a furanoside is necessarily unstable and furnish argument in support of their view.

(3) α-Amylase splits amylose to produce not only maltose, as required by the hypothesis, but also appreciable quantities of glucose and maltotriose. This requires the enzyme to attack two very different α-glucosidic links and at different rates. Alternatively, the mutarotase function postulated above could, if slowly operated, give opportunities for the open chain to break away at its reducing end. This would be assumed to happen in a certain proportion of the cases, depending on the relative rates of exercise of these two functions. The different types of α-amylase might vary among themselves in this respect. (Incidentally, any lag in this liberation of glucose could well account for the anomaly reported by Kuhn[2], a sudden rise in rotation during the action of pancreatic amylase.) The removal of glucose in such a way would give rise to a dextrin with an odd number of glucose residues in it, ultimately yielding maltotriose. But this maltotriose would contain a furanose residue in the middle position.

(4) The structure of maltotriose has recently[9] been established as that of three glucopyranose units. It is true that the material investigated might have originated from a portion of the starch (amylopectin) near the branch-points to which the pyranose–furanose structure need not apply. However, maltotriose is definitely formed from amylose by α-amylases[10,11], and appears in some cases in the comparative absence of glucose.

(5) The mechanism of action of phosphorylase[12] and amylo-glucosidase[13] in forming respectively glucose-1-phosphate and glucose from a chain with alternate pyranose and furanose residues is difficult to work out, and, as with α-amylase, requires specificity for two different links. On the other hand, the need for a primer of three or four groups in length to initiate synthesis of phosphorylase[14] could be well accounted for.

Altogether, it must be concluded that the hypothesis put forward by Blom and Schwarz creates more difficulties than it clears up. Nevertheless, their experimental results call for explanation. These and the discrepancy in the $[\alpha]_D$ of starch, referred to above, are due to the same cause, with which the upward mutarotation of β-amylase fission products may also be associated. Explanation may well be found along the line that the α-glucosidic residues in the middle of a chain are pyranose but nevertheless possess very decidedly lower optical rotatory power than in maltose. Calculation of the value of $[\alpha]_D$ of maltotriose from the values of α-glucose and maltose leads to + 168° for the solution in water at equilibrium. If maltotriose derived from amylose, possessing $[\alpha]_D$ + 158° as found in these laboratories (cf. French *et al.*[15]), can be shown to be composed solely of α-glucopyranose units, as Wolfrom has done for what appears to be the same compound, this would go far to account for the $[\alpha]_D$ of starch, since the value 158° is in good agreement with the Freudenberg rule. [Oct. 3.

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LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

A New Blood-Group Antibody, Anti-Jk^b

THE human blood-group system called *Kidd* was discovered in 1951 by Allen, Diamond and Niedziela[1], who found an antibody, anti-Jk^a, which distinguished two phenotypes, $Jk(a+)$ and $Jk(a-)$. Family investigations[2] showed that the antigen Jk^a is inherited and that the gene Jk^a is capable of expressing itself in single and in double dose; the existence of an allelomorphic gene Jk^b was assumed. In tests on 390 unrelated persons[3], the phenotype frequencies were $Jk(a+)$ 76·92 per cent and $Jk(a-)$ 23·08 per cent, from which the following gene and genotype frequencies were calculated:

Genes		Genotypes	
Jk^a	0·5196	Jk^aJk^a	0·2700
Jk^b	0·4804	Jk^aJk^b	0·4992
		Jk^bJk^b	0·2308

The finding of the antibody corresponding to the antigen, and gene, Jk^b is here reported. It has been found in the serum of Mrs. W. Mrs. W. gave birth to full-term healthy infants in 1937 and 1940 and had miscarriages in 1944 and 1951. There is no history of haemolytic disease of the newborn. She was transfused with blood after the second and again after the fourth delivery. The latter transfusion had to be stopped owing to a rigor, and because of this her serum was examined.

The blood groups of Mrs. W. are *O, MsMs, P+, cDE/cde, Lu(a−), K−, Le(a−b+), Fy(a−), Jk(a+)*. Her serum contains anti-Fy^a as well as anti-Jk^b. The more powerful anti-Fy^a was recognized first; the presence of anti-Jk^b was suspected from the results of tests on $Fy(a-)$ red cells. The anti-Fy^a was removed by absorption, leaving in the serum anti-Jk^b alone. The cells used for this absorption were from a person known to be homozygous Fy^aFy^a and thought, from previous dosage work with anti-Jk^a sera, to be homozygous Jk^aJk^a.

That the antibody left in the absorbed serum is indeed anti-Jk^b is shown as follows.

(1) Ninety-eight members of the staff of the Lister Institute have been tested, with the following results:

		$Jk(a+)$	$Jk(a-)$
Mrs. W.'s serum absorbed	+	44	19
	−	35	0

If the new antibody were not related to the *Kidd* groups the 'exact' probability of getting such a result would be only 1 in 14,129. There is no association with any of the other blood-group antigens, with sex or with the ability to taste phenyl thio-carbamide.

(2) All 19 $Jk(a-)$, that is, Jk^bJk^b, persons so far tested are positive, and so are all of 22 persons known from family studies to be heterozygous Jk^aJk^b. (Seven of these heterozygotes are in the Lister 98; a further 15 were selected and do not appear in the 2 × 2 table.) If the new antibody were not associated with Jk^b the chance that all 41 persons should be positive is but one in many thousands.

(3) The positive reactions of the new antibody are, on the average, a little stronger with $Jk(a-)$ than with $Jk(a+)$ red cells.

The new antibody in the serum of Mrs. W. is therefore anti-Jk^b. Of the 79 $Jk(a+)$ persons in the 2 × 2 table it can be calculated that about 51 should be Jk^aJk^b, and therefore positive with anti-Jk^b, while 28 should be Jk^aJk^a and therefore negative; in fact, 44 were positive and 35 negative, which is not a significant departure from expectation ($\chi^2 = 2·9$ for 1 degree of freedom).

The presence of anti-Jk^b in this serum was first demonstrated by the indirect anti-globulin method, but was not detectable by the trypsin or other tests. The reactions were weak. It was then found, however, that an indirect anti-globulin test on trypsinized cells, a combination of tests recommended by Unger[3], gave very clear results.

The existence of the antibody anti-Jk^b promotes the *Kidd* system to fourth place in the order of 'usefulness'[4] of the nine blood-group systems. 'Usefulness' is a measure, suggested by Fisher, of the potential value of the systems in human genetics and in problems of identity, parentage and paternity.

We are grateful to Mr. Norman White and Dr. Martin Hynes, of the Royal Northern Hospital, Holloway, for their co-operation; we also acknowledge, once again, the kindness of our long-suffering colleagues at the Lister Institute in giving innumerable samples of blood.

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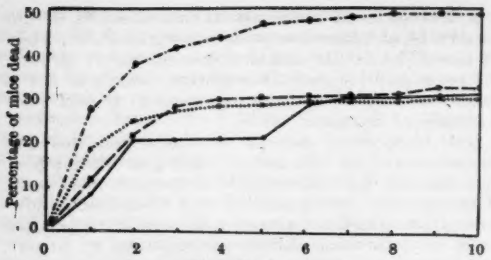
Effect of Hyaluronidase on the Mortality from Experimental Burns

IN treating secondary shock, the intravenous route of fluid administration may not be possible under certain conditions, as, for example, in small infants or in the event of a catastrophe when sufficient trained personnel are not available. In lieu of the intravenous route, the interstitial administration of fluids containing hyaluronidase to assist assimilation has been used clinically in recent years[1]. With the addition of this enzyme to break down hyaluronic acid, the fluid spreads more rapidly throughout the connective tissue, thereby entering the capillaries more rapidly, with a consequent increase in the effectiveness of the shock therapy.

If hyaluronidase is to be used in hypodermoclysis, however, it is important to establish that it exhibits no adverse effects otherwise on the shocked individual as, for example, in burns. For this reason, the effect of hyaluronidase on burned, shock-treated animals was studied experimentally.



Influence of hyaluronidase on mortality of mice after an experimental burn.
○ — . — . — ○, 'Hydase' applied at burn site (80 mice); × ..... ×, heated 'Hydase' (control) at burn site (80 mice); ■ — — — ■, 'Hydase' injected distally (60 mice); ●——●, heated 'Hydase' (control) injected distally (60 mice)

Adult, male, Connaught strain white mice deeply anæsthetized with 'Nembutal' were subjected to a standard burn produced over the dorsum by immersing a constant fraction (one-third) of their body weight in water at 70° C. for 20 sec. The mice were afterwards treated for shock with 1 c.c. of physiological saline administered intraperitoneally in two doses: 0·5 c.c. immediately after the burn, the other 0·5 c.c. two hours later.

Three sets of paired experiments were carried out, one in which the hyaluronidase (Wyeth 'Hydase') was added to the saline given intraperitoneally, one in which the hyaluronidase was injected subcutaneously (0·1 c.c.) in an area remote from the burn, and a third in which the hyaluronidase was applied locally to the burned area in 0·25 c.c. saline. The latter two studies were carried out in paired experiments in which the control mice received equal quantities of hyaluronidase which had been inactivated by heating at 100° C. for 15 min. The results are shown in the accompanying table. In addition, the graph illustrates the time-course of the mortality of mice treated locally to the burn and subcutaneously distally with 50 turbidity reducing units of hyaluronidase and of the controls similarly treated with the inactivated enzyme.

From these observations, it is seen that the mortality of the burned mice treated with hyaluronidase intraperitoneally or subcutaneously distal to the burn is essentially the same as that of the controls. The addition of even relatively large doses of hyaluronidase by these routes, therefore, has not otherwise prejudiced the chances of survival of the burned animals. Conversely, however, the local application of hyaluronidase directly to the burned surface has definitely increased the mortality in the burned animals. With 50 turbidity reducing units of enzyme, this increase is significant at the $P = 0{\cdot}03$ level. From the limited series of animals treated marginally with 15 units, it seems that an increased mortality is also produced with smaller doses of hyaluronidase applied locally in the burned area.

Effect of Hyaluronidase on the Mortality of Burned Mice

Dose of hyaluronidase or inactivated hyaluronidase	Mode of administration	Total No. of mice burned	No. dead in 10 days	Per cent dead
1·5 TRU* enzyme	Subcutaneously in 0·1 c.c. saline distal to burn	40	12	30
1·5 TRU inactivated		40	11	28
15 TRU enzyme		39	10	26
15 TRU inactivated		38	11	29
50 TRU enzyme		60	20	33
50 TRU inactivated		60	19	32
0 TRU enzyme	Intraperitoneally (in saline)	26	11	42
0·02 TRU "		26	10	38
0·5 TRU "		26	8	31
12·5 TRU "		26	8	31
Saline	Subcutaneously into margin of burn (0·1 c.c.)	20	10	50
15 TRU enzyme		20	13	65
50 TRU inactivated	Applied to burn surface in 0·25 c.c. saline	80	25	32
50 TRU enzyme		80	40	50

*TRU = turbidity reducing units.

The increase in mortality observed when hyaluronidase was applied to the burned skin with the consequent breakdown of the hyaluronic acid in the wound may result either from an increased absorption of toxic material from the burn or from increased loss of fluid into the wound or from a combination of these factors. At post-mortem the burns treated locally with hyaluronidase seemed to be more œdematous than those similarly treated with the inactivated enzyme. Sections of the burned skin treated with hyaluronidase or with inactivated hyaluronidase locally were therefore examined for œdema. The mean full-skin thickness from the burn in seven sections of mice treated with hyaluronidase was indeed found to be slightly but measurably greater when compared with seven sections from mice treated with the inactivated hyaluronidase. The areas were measured quantitatively by projection. This small sampling thus tends to confirm objectively the post-mortem impression.

From this experimental work in animals, it is concluded that tests to establish the safety of using hyaluronidase in hypodermoclysis in the treatment of burned patients are probably justified clinically in areas away from the burn, since no adverse effects could be shown with relatively large doses of hyaluronidase, provided the enzyme was given subcutaneously distal to the burned area or intraperitoneally.

This work was carried out under contract between the Defence Research Board of Canada and the Hospital for Sick Children, Toronto.

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Lipoids and Cholesterol in New-born Rats

The organism of new-born rats is subjected to many post-natal changes. Certain organs, and probably all the body, will achieve in stages the functions which they have in the adult animals. It has been stated that the hypophysis develops its complete functions after birth. Heller[1] found in the hypophysis of new-born rats ten times less adiuretine than in adults. Schreiber[2] noticed the embryological, anatomical and physiological relation of the neurohypophysis, hypothalamus and visual organs, and was led to look for correlation with the evolution of the water metabolism of new-born rats as the expression of the action of the diencephalo-pituitary system and the functional evolution of the eye. He observed that, in rats just beginning to see, the dry matter is increasing and chlorides decreasing with

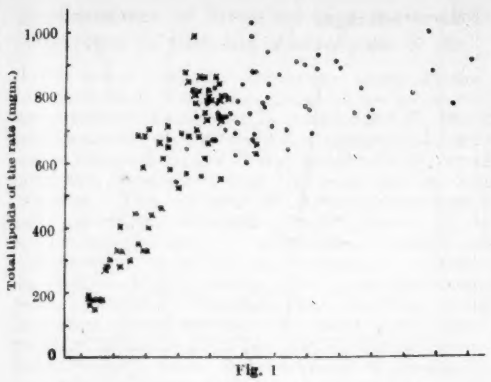

Fig. 1

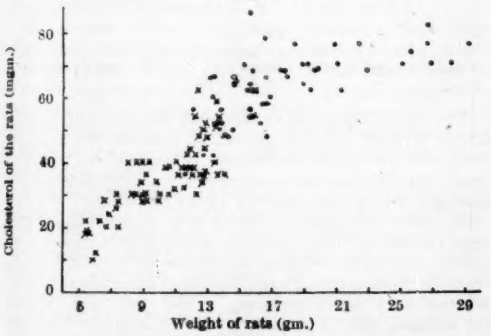

Fig. 2

Fig. 1. Relation of total lipoids to the body-weight of new-born rats. ×, Rats which could not see; O, rats which could see

Fig. 2. Relation of cholesterol to the body-weight of new-born rats. ×, Rats which could not see; O, rats which could see

the growth in weight. The decrease is quicker in rats before their eyes are open. He explains his results as the completion of evolution of the neuro-hypophysis at the time when the rat is just beginning to see.

In the present work, the content of total lipoids and cholesterol in albino rats was found from birth to the age of twenty days, with particular regard to that time when they begin to see.

Young rats from twenty-one litters, each litter of average number six rats, were used, and it was noted whether each animal could see or was blind. This change happens normally at about the thirteenth day after birth. The animals were minced, and extracted three times with excess of boiling alcohol–ether (3 : 1). In the whole extract, total lipoids were determined gravimetrically after extraction with petroleum ether. Cholesterol of the same extract, was determined colorimetrically by the Liebermann–Burchard reaction.

From the graphs it is evident that the amount of total lipoids increases more quickly with increasing weight in the blind rats than in the rats which could see. A less distinct increase occurs for cholesterol.

This smaller increase of lipoids is not shown in the amount of dry matter of rats, which Schreiber describes in his work. On the other hand, dry matter increases more in rats which can see than in blind rats. Therefore it is evident that at this time the increase of proteins must be higher than the increase of lipoids.

Treatment of animals with anterior lobe of hypophysis results in increased utilization of lipoids, especially of glycerides[3]; cholesterol is not affected in this way. It is possible that the smaller increase of lipoids and greater increase of proteins in rats when they begin to see may be related to a certain state of development of the hypophysis.

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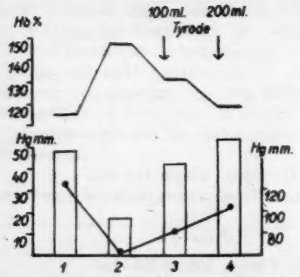
Response of the Vascular System to Sympathetic Stimuli during Shock

SHORR and co-workers[1], in studying the state of the vascular system in shock, showed that in the later stages of variously induced shock a vaso-depressor substance appears in the blood of dogs, and that this substance, injected into rats, reduces the spontaneous vasomotion of the vessels of the mesoappendix and sensitivity to adrenalin. They later identified the substance as ferritine[2]. In their opinion, the vaso-depressor substance has an important role in the patho-mechanism of shock.

In our experiments, we have studied the effect on the blood pressure of splanchnic stimuli and of adrenalin injections in animals in hæmorrhagic or tourniquet shock. Experiments were carried out on seventy-nine dogs under chloralose anæsthetic. Hæmorrhagic shock was induced by gradually drawing 35 ml./kgm. blood; ischæmic shock by 4–5 hr. ligature of the rear limbs (tourniquet). In both types of shock, 90 per cent of the animals succumbed within 7–8 hr. The adrenalin was given intravenously in 20–40 μgm. doses, choosing the dose so far as possible to bring about a rise in blood pressure equal to a 10-sec. splanchnic stimulus. Comparison of the adrenalin and splanchnic sensitivity was made in the same animal before and after inducing shock.

Our results show that, both in hæmorrhagic and in ischæmic shock, the blood pressure following splanchnic stimulus or as the effect of adrenalin pressor has a value of 17–21 mm. mercury, as against the initial 45–50 mm. mercury. Decreased splanchnic and adrenalin responsiveness could already be observed 1–2 hr. before death, when the systemic blood pressure was about 60 mm.

The phenomenon can be explained by Shorr's theory of a vaso-depressor substance; but it seemed possible that the hæmo-concentration, or the reduced quantity of circulating blood in shock, might bring about the diminished adrenalin and splanchnic response. To determine this, in further experiments we investigated the effect of re-injecting the blood drawn, or Tyrode infusions of varying quantity, on splanchnic and adrenalin sensitivity. The rise in blood pressure due to the adrenalin, the systemic blood pressure and percentage hæmoglobin are shown in the accompanying diagram (mean values for eight ischæmic shock experiments). From the diagram can be seen, on one hand, the degree of reduction in adrenalin sensitivity in shock, and, on the other, that when the hæmoglobin-level reaches its initial value as the result of the infusions, adrenalin sensitivity is also re-established. There is a correlation



Effect of adrenalin on blood pressure in millimetres of mercury, □; systemic blood pressure, ●—●; upper curve, hæmoglobin per cent; (1) before inducing shock; (2) during shock; (3) after infusing 100 ml. Tyrode; (4) after infusing 200 ml. Tyrode

between the two values ($r = -0{\cdot}86 \pm 0{\cdot}14$). The splanchnic stimulation behaves in essentially the same manner. In hæmorrhagic shock, transfusion of the drawn blood likewise normalizes the splanchnic and adrenalin responsiveness.

From these results it would seem that, conflicting with the theory of a vaso-depressor substance, the diminution in splanchnic and adrenalin sensitivity in shock is due primarily to the reduced amount of blood in circulation.

More detailed results will appear in the *Acta Physiologica Hungarica*.

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Budapest. June 22.

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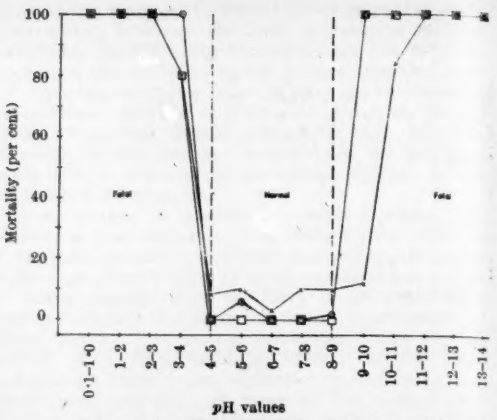
Effect of Changing *p*H on Developing Trout Eggs and Larvæ

A change in the *p*H value of the surrounding water has been observed to have a marked influence on the life and growth of trout eggs and larvæ. Normally, they are reared in water of *p*H $7{\cdot}30 \pm 0{\cdot}05$ at $10{\cdot}5°$ C. The *p*H value of the yolk in living eggs and larvæ is 6·50–6·55, and after death it has the same *p*H value as that of the surrounding water. As a starting point for an investigation of the effect of different *p*H values on eggs and larvæ, they were reared in tap water adjusted to different *p*H's with hydrochloric acid and sodium hydroxide. Such a system would not remain at constant *p*H. Since it was found that a particular quantity of water in a glass vessel containing fifty eggs did not change its *p*H in 6 hr. by more than 1·0 towards the acid side, the water of the experimental container was replaced after 6 hr. with fresh water adjusted to the original *p*H. Buffer solutions were not used to avoid the action of other ions. All the containers were kept in the same hatchery tray at a constant temperature of $10{\cdot}5° \pm 0{\cdot}5°$ C., and each container received 50 eggs. The larvæ need more oxygen and give out more carbon dioxide than the same number of eggs, so the quantity of water in each container was increased to five times the original to ensure the proper aeration of the larvæ. A simple average of the mortality percentage of four experiments is shown in the graph. All *p*H values were measured with a glass electrode and Cambridge *p*H-meter at $10{\cdot}5°$ C.



— —, Ova one day after fertilization; ○—○—, eyed ova about three weeks after fertilization; □—□—, larvæ one day after hatching

The graph shows that the eggs can develop normally in a fairly wide range of *p*H, outside which there is an abrupt rise in mortality. It also shows that the eyed ova and the larvæ are equally susceptible to *p*H changes, but green ova are more resistant.

In alkaline medium. There was endosmosis. The eggs swelled and the vitelline cavity was reduced very much. The yolk became white due to contamination with external water. The frozen sections of the eyed ova showed very little breaking of the yolk emulsion at its surface, and it appeared that metabolic activity was very much slowed down.

In acidic medium. In this case there was exosmosis. The egg yolk inside the eggs shrank, and the vitelline cavity widened. The yolk even in the dead eggs was not white, showing that it was not contaminated with external water. The frozen sections of the eyed ova showed an increase in the breaking of yolk emulsion at its surface. The metabolic activity appeared to be accelerated in this case.

It is suggested that the alkali saponifies the lipoids of the vitelline membrane, making it permeable to water, and also retards the activity of the extra-embryonic blastoderm in yolk metabolism. On the other hand, acid does not remove the lipoids of the vitelline membrane and its impermeability to external water is maintained. The acid appears to accelerate the metabolic activity of the extra-embryonic blastoderm on the yolk surface.

In these experiments there can be two factors which would affect the eggs and larvæ: (1) the change of *p*H value of the surrounding medium, and (2) carbon dioxide given out by the eggs and larvæ during respiration. The latter point was raised by Young[1] while studying the effect of changing *p*H values on adult fishes. In the present experiment this factor was negligible because the quantity of carbon dioxide given out by the eggs would be much smaller than that given out by adult fishes. In any event, it was found that the carbon dioxide factor was common to both treated and control containers.

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Occurrence of Nicotine together with Hyoscine in *Duboisia myoporoides* R. Br.

THE genus *Duboisia* comprises three species: *D. hopwoodii* F. Muell. is confined to the interior of the Australian continent, *D. leichhardtii* F. Muell. has a restricted occurrence in the highlands of south-eastern Queensland, and *D. myoporoides* R. Br. occurs along the eastern coast of Australia and in New Caledonia. The leaves of all three species contain major quantities of alkaloids; but the genus is unique in that one species, *D. hopwoodii*, contains the pyridine alkaloids nicotine and *nor*-nicotine, whereas the other two contain various alkaloids of the tropane group. Efforts to detect tropane alkaloids among the minor alkaloids of *D. hopwoodii* have failed. Similarly, although the other two Australian species contain volatile bases, the occurrence of nicotine or *nor*-nicotine has not been demonstrated.

A sample of seed of *D. myoporoides* from New Caledonia was recently obtained for us by the South Pacific Commission. Seedlings were established at Canberra both in the field and in a heated glasshouse. Although the plants in the field were stunted, those in the glasshouse grew well and were very similar to adjacent plants of *D. myoporoides* grown from Australian seed.

Alkaloid assays were carried out by a modification of the partition chromatographic method described by Loftus Hills and Rodwell[1]. Working with *D. hopwoodii*, it had been found that nicotine and *nor*-nicotine are well separated by the procedure in routine use for separation of tropane bases. In all chromatograms of material of New Caledonian origin, peaks were obtained in the positions for nicotine, hyoscine and *nor*-nicotine. The identity of hyoscine in each chromatogram was established by preparation of the picrate or reineckate, the melting points of which were not depressed on admixture with the compound prepared from authentic hyoscine. It gave a positive Vitali–Morin reaction, and when run on a paper chromatogram, using butanol – acetic acid – water to form the phase pair, a single spot was obtained with the same R_F value as that obtained with hyoscine. To identify nicotine, the dipicrate was prepared and checked by mixed melting point with nicotine dipicrate prepared from tobacco. The *nor*-nicotine was similarly identified, using *nor*-nicotine from *D. hopwoodii* for comparison. Also, for both these fractions, paper chromatograms showed single spots in the expected positions.

The partition chromatograms also showed small amounts of other bases. Material eluted in the position where hyoscyamine would be expected gave a positive Vitali reaction, and a paper chromatogram showed a spot with the same R_F value as hyoscyamine. The leaf samples contained approximately 0·1 per cent of this material.

The method of assay, although giving reliable quantitative data for hyoscine, only gives an indication of the amounts of nicotine and *nor*-nicotine present, as losses on drying are uncertain[2]. Of the seven samples of *D. myoporoides* from New Caledonian seed examined, the first was a composite bulk from eight field trees, and the remainder were from individual plants in the glasshouse. The amounts of hyoscine, nicotine and *nor*-nicotine, expressed as a percentage of the dry weight of the leaf, are shown in the accompanying table.

This appears to be the first occasion upon which alkaloids of the tropane and pyridine groups have been observed to occur in the same plant, or even in the same species. In the genus *Duboisia* in Australia, these two phytosynthetic mechanisms are sharply isolated by the species boundaries; but they exist together in this New Caledonian form, the origin of which is a matter of conjecture.

D. myoporoides (*ex* NEW CALEDONIAN SEED)

Origin of sample	As percentage of dry weight of leaf		
	Nicotine	*nor*-Nicotine	Hyoscine
Field, Canberra A.C.T.	0·9	0·2	0·4
Single plants, glasshouse, Canberra, A.C.T.	0·7	0·2	0·25
	0·6	0·3	0·4
	0·9	0·2	0·4
	0·5	0·25	0·35
	0·7	0·3	0·5
	0·7	0·2	0·55

The geographical remoteness of New Caledonia from the area in which *D. hopwoodii* occurs and the morphological similarity of this material with *D. myoporoides* do not support a theory of hybrid origin. Possibly internal changes involving the pattern or nature of the genes were responsible. On the other hand, the New Caledonian material may be a relict of a primitive form from which the genotypes of the Australian mainland originated.

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[1] Loftus Hills, K., and Rodwell, C. N., *Aust. J. Sci. Res.*, B, **4**, 486 (1951).
[2] Bottomley, W., and White, D. E., *Aust. J. Sci. Res.*, A, **4**, 107 (1951).

Uptake of Dyes into Cut Leaves

THE limitation of petiolar uptake of solutes by detached leaves shown in the following experiments does not seem to have been previously recorded.

Leaves of *Atropa belladonna* L. and of cherry laurel (*Prunus laurocerasus* L.) were placed with their petioles in dilute solutions of the basic dyes methylene blue and safranin, and of the acid dye acid fuchsin. In two to three hours approximately 0·25 ml. of the acid fuchsin had been taken up and could be seen by the naked eye, and by the microscope, to have reached the finest ramifications of the leaf vascular system.

Uptake of the basic dyes was very much slower; but the safranin experiment was prolonged until approximately 0·5 ml. had been taken in. No colouring of the leaf was noticeable, and lengthwise cutting showed that all the dye had been retained by the first half-inch of the petiole; methylene blue, which is not so basic, had stained approximately the first inch. Such an immovable accumulation of dye molecules in the xylem vessel lumen would naturally impede fluid intake, and the leaves did, in fact, wilt.

The experiment was repeated for cherry laurel leaves using penicillin and streptomycin, which are respectively acidic and basic antibiotics. The concentration in both cases was 1,000 units/ml., and the solutions were at *p*H 5. Uptake of penicillin solution was rapid, but of streptomycin solution very slow. At varying times disks were removed by means of a cork-borer from parts of the leaf distal and proximal

to the petiole. These were finely chopped, and tested for antibiotic content in the usual manner with bacteria-seeded test plates. A well-marked concentration of penicillin was found to have entered the leaves in only 45 min., whereas streptomycin could not be detected after four hours.

Such facts are satisfactorily explained by supposing the xylem elements to be negatively charged. As such they would hinder, or prevent, the intake of basic organic molecules, which are positively charged, while not interfering with, or even accelerating, the intake of negatively charged acidic molecules. There seems to be no reason why this condition should not prevail in the intact xylem system; but it would scarcely affect such mobile positively charged particles as the sodium or potassium ions commonly found there.

The origin of the charge is possibly as follows[1]: negatively charged OH′ ions, formed from ionized water molecules, induce a dipole separation of charges in the non-ionizing cellulose and lignin of the xylem. This polarization causes an attraction to arise between the OH′ ions and the xylem surface, which is sufficiently great to overcome the thermal energy of the ions. Consequently, the OH′ ions are bound to the xylem surface, which thus becomes negatively charged. For explanation of the special ability of anions, particularly OH′ ions, to induce charged surfaces of this type, ref. 1 should be consulted.

Petiolar feeding of leaves may be said to have as its objective the administration of substances to the mesophyll cells in the most 'natural' way. The above results suggest that the method may be unsuitable for administering basic substances, in which case infiltration technique should be used.

It might further be added that while acidic substances, as judged from rapid petiolar intake of their solutions, enter the xylem with ease, this is no guarantee that they obtain rapid access to the chlorophyll-containing cells. Speed of access to these cells will be determined by the semi-permeable properties of the close-fitting cells sheathing the xylem and its branches; for an unstable substance like penicillin any considerable delay would be serious.

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Oxford Medicinal Plants Scheme,
Department of Botany,
Oxford. Dec. 17.

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Orientation of Telotrematous Brachiopoda

A study of the development of the rhynchonellid, *Tegulorhynchia nigricans*, Sowerby, shows the larva to be furnished with two pairs of large tufts of long setæ set on the hind margin of the mantle rudiment. The members of one pair lie dorso-laterally, those of the other pair laterally. On the mid-ventral surface of the larval mantle is a longitudinal thickening of ciliated cells some 70 μ long and reaching to the hind edge. Two bands of muscle fibres pass forward inside the larval pedicle and are finally inserted one each side of the mid-dorsal line of the base of the mantle.

After attachment and mantle reversal, the dorso-lateral tufts of setæ are found on the edge of the brachial valve near the mid-line, and the lateral tufts are found laterally on the edge of the pedicle valve. Lying mid-longitudinally on the inner face of the pedicle valve is a short cellular thickening which is probably derived from that on the mid-ventral side of the larval mantle. Adjustor muscles pass between the stalk and the pedicle valve. Other muscle pairs are present, notably the divaricators. It is clear that the ventral part of the larval mantle gives rise to the pedicle valve of the young adult and that the dorsal portion of the larval mantle provides the brachial valve.

The fact that immediately after mantle reversal a pair of adjustor muscles passes between the stalk and the pedicle valve shows that the larval muscle bands consist of more than adjustor elements and that their inner portions give rise to other muscles, those likely being the divaricators, the upper ends of which lie alongside the ends of the adjustors inserted on the pedicle valve.

The well-marked features of the late larva of *Tegulorhynchia* make possible the ready relation of the external structures of that phase with those of the young adult immediately after metamorphosis.

In the case of *Terebratella inconspicua* Sowerby, the development of which has been described[1], the larva possesses little externally which can be reliably followed through metamorphosis. The setæ are minute, few, squarely set about the long axis, and useless for orientation. The median ventral thickening, about 35 μ long, has not been traced immediately after reversal; but a small thickening appears on the inner face of the pedicle valve when the mouth forms, and projects somewhat into the latter. Whether this is a reappearance of the original thickening is not certain. The guide through metamorphosis for orientation was taken as the pair of muscle bands in the larval pedicle, passing forward to the dorsal side. These muscles were considered to become the pair of adjustors of the young adult, thus making the pedicle valve morphologically dorsal.

The observations on the metamorphosis of *Tegulorhynchia* bring into question the value of the interpretation of the metamorphosis of *Terebratella inconspicua*. The interpretation of the latter metamorphosis in terms of that of *Tegulorhynchia* simplifies what would otherwise be complex and is in accord with similarities of other kinds which exist in the two developments.

The earlier interpretation of the metamorphosis of *Terebratella* is discarded and is replaced by one which makes it agree essentially with that of *Tegulorhynchia*. The orientation of the two young adult brachiopods is then similar to that of *Lingula*, as described by Yatsu[2].

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Aug. 22.

[1] Percival, *Trans. Roy. Soc., New Zealand*, **74**, 1 (1944).
[2] Yatsu, *J. Coll. Sci. Imp. Univ., Tokyo*, **17**, 1 (1901–3).

Determination of Adrenalin and Noradrenalin in the Human Fœtal Adrenals and Aortic Bodies

The adrenalin content of the fœtal adrenals has been studied in experimental animals by biological and chemical methods to a relatively insignificant extent; corresponding studies on human material are scarce. Lelkes[1] has shown by biological methods that as early as towards the end of the third fœtal

month the human adrenal gland already contains adrenalin, and beginning with the fifth month it can also be demonstrated more abundantly in Zuckerkandl's body. The noradrenalin content of the human fœtus has scarcely been studied at all. Therefore, we have attempted to make a chemical determination of the noradrenalin and adrenalin in human fœtal adrenals and Zuckerkandl's body at different stages of the intrauterine period.

The series comprised nineteen cases ranging from 230 up to 4,270 gm., in which determinations were performed by the micromethod. In collecting the material, particular consideration was given to its freshness. Noradrenalin and adrenalin were determined in a trichloracetic extract according to v. Euler's and Hamberg's iodine oxidation reaction[2], carrying out oxidation both at *p*H 4 and 6.

During the last three months of the intrauterine period the total catechols of the adrenals averaged 71 μgm. The corresponding figures for the aortic bodies were 40 μgm. and 11 μgm. respectively. The ratio between the catechols of the aortic bodies and the adrenals remained constant throughout fœtal life. The total catechols of the adrenals and aortic bodies per kgm. of body-weight were somewhat less than the corresponding amount in normal adult adrenals (in cases of sudden death).

A considerable part of the total catechols in the adrenals consisted of noradrenalin; in three-quarters of the cases noradrenalin accounted for more than half, which is notably more than in adult humans. The preponderance of noradrenalin in the aortic bodies was even more pronounced, amounting on an average to five-sixths of the total catechols during the last three months of intrauterine life.

The concentration of catechols in the fœtal adrenals was found to be considerably less than in the adult glands (1 : 50), due to the large cortex characteristic of fœtal life.

No clear correlation could be established between concentrations of catechol in the organs studied and difficulties of labour. Normal amounts of catechol were found even in prolonged asphyxia.

A full account of this work is being published elsewhere[3].

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Spontaneous Parthenogenesis in a Fish

The guppy, *Lebistes reticulatus*, is a viviparous fish the reproductive physiology of which has been well studied (bibliography in Gordon[1]). A female, *D*9, of English domestic stock of this species born October 5, 1950, was separated from adult males twelve days after birth. The litter of which she was a member were placed in separate jars when thirty-nine days old. The first sign of differentiation of the anal fin into a gonopodium was seen in one of her brothers twelve days later, the family being raised at 20° C. The isolated female, at the age of 216 days, bore a female offspring which died at the age of 304 days. The mother was then mated to a male litter-mate, and bore four litters of at least twenty-six, of which twenty-four were females and one male. The male mated with *D*9 died before the birth of the second litter, consisting of seven females and one male which were separated from each other at the age of four days. One of these females, *DD*20, gave birth to three young at the age of 193 days.

The first example of unexpected births could be explained by fertilization of the female by an adult male during her first twelve days or by an immature brother during the first thirty-nine. The second could only be explained by fertilization of a female aged less than five days by a male of the same age, which, however, showed no sign of gonopodial differentiation until thirty-eight days old. Even if the gonads matured early, it is difficult to see how internal fertilization could have been achieved with an unmodified anal fin. Winge[2], after prolonged experience, states that "males and females should be separated as soon as the sex can be determined, i.e., 2–3 weeks before maturity is reached".

Amateur breeders have described parthenogenesis in fish verbally on several occasions; but do not seem to have published any repetition of their observation under controlled conditions. Considering the ease with which artificial parthenogenesis can be obtained in some vertebrate groups[3], the same phenomenon would be expected to occur spontaneously, and has been reported[4].

(*February* 14, 1953. Three further anomalous litters have been born. All nine fatherless fish old enough for the sex to be recognized are females.)

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Somatic Reduction Division in the Development of the Sea Urchin

In the sixteen-cell stage of the sea urchin egg, four micromeres occur around the vegetal pole. At the following division, which is delayed in the micromeres[1], these cleave off 'small micromeres', which behave in many respects differently from the rest of the embryo[2]. They do not flatten against their neighbours, appear optically empty in dark-field illumination, and cannot be vitally stained, for example, by nile blue sulphate. In all these respects the small micromeres resemble the polar bodies[2]. This suggests a deeper similarity, namely, that the small micromeres function as 'somatic polar bodies', the division leading to their formation implying a reduction of the chromosome number.

Studies were made of sections of *Paracentrotus lividus* (Lamarck) from Naples. The diploid chromosome number of this species[3] is 36. In three embryos with the micromere division in late telophase to early anaphase, the number was found to be 18. In some embryos with early anaphase stages and the chromosomes in two different sections, the chromosome number of the two groups varied between 17 and 21,

the higher numbers probably depending on fragmentation of some chromosomes. In many divisions in metaphase the number of chromosomes could not be exactly counted, but was estimated to fall between 32 and 40. It is thus obvious that the division of the micromeres implies a reduction of the chromosome number to half.

Material of *Strongylocentrotus drœbachiensis* (O. F. Müller) was obtained on the west coast of Sweden. Also in this species the division of the micromeres yields haploid nuclei. The haploid number calculated from seventeen haploid and sixteen diploid chromosome counts was 20·2. This agrees well with that observed from an equatorial plate in polar view of a micromere. Here a pairing of the forty chromosomes is taking place, being equivalent to the 'secondary pairing' in mitosis (Diptera and polyploid plants) and meiosis (plants) (cf. Darlington[4]).

Somatic reduction divisions seem not to have been observed in animals, but are known to occur spontaneously in plants, and have also been experimentally induced (cf. Battaglia[5]).

The micromeres and their descendants have very important functions. During the blastula stage this material has a high potency in restraining the tendencies towards extension of the animal differentiations and, when transplanted into isolated animal halves, in inducing vegetal differentiations[6]. Later, it produces skeletal substance. Possibly these functions depend upon the haploid state. An experimental analysis of these and related problems is in progress.

A detailed account of this work will appear in *Experimental Cell Research*.

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Reversal of Phototaxis in Prepupæ of Hymenoptera (Tenthredinidæ) caused by Amyl Acetate Vapour emanating from Marking Paint

In autumn the grass-feeding larvæ of *Tenthredopsis litterata* Geoff. and *T. nassata* F. undergo an ecdysis prior to entering the soil at plant roots, where they remain as overwintering non-feeding prepupæ until pupation occurs in the following summer.

The newly formed prepupæ, although lethargic, exhibit positive phototaxis; but within a period of two or three days they become more active and photonegative. This negative phototaxis appears to direct them to the pupation site in soil, and at present there is no evidence that a gravity reaction is involved.

While investigating the details of the taxis mechanism, a cellulose lacquer was used for occluding in part the vision of active photonegative prepupæ. For a period lasting from a few minutes up to two hours, prepupæ so treated became strongly photopositive, but afterwards reverted once again to their pre-treatment photonegative condition. Further experiment showed that paint placed on other parts of the body produced the same effect, and that this reversal of reaction to light could also be caused by previous treatment for a short period with the vapour of amyl acetate, or handling by instruments contaminated by this vapour. Prepupæ so treated, after being photopositive for a while, returned to their original photonegative condition fairly abruptly and usually within a minute of such a reversal tendency being observed. Ethyl acetate, acetone and chloroform vapours did not alter the reactions of prepupæ to light.

The above observations were made in a dark room on prepupæ moving in a horizontal plane with respect to a diffuse lateral beam of light. The beam emanated from a 100-watt lamp bulb placed 45 cm. from the experimental area and shone through an aperture 5 cm. × 3 cm., across which was placed a glass vessel containing water. Further experiments were conducted to ensure that variation in light intensity, heat gradients, nature of substratum and previous exposure of prepupæ to light were not responsible for the observed reversal of behaviour.

Since amyl acetate is a constituent of paints which may be used in various experiments involving insect behaviour, it is felt that these observations might be of particular interest to workers in such fields.

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Manganese Requirements of Tomato Plants at Different Phases of Growth

During investigations on the iron and manganese requirements of plants[1], it was decided to determine whether tomato plants required a continuous supply of manganese throughout their growth or whether the element was more essential at one phase than at another. Investigations on similar lines have been reported by Gericke[2] for wheat and by Brenchley[3] for barley. These workers, however, were concerned with the major nutrient elements.

The method used was the water culture technique[1] and the general plan of the experiment is shown in Table 1.

Table 1

Treatment designation	Period I 1st 2 weeks	Period II 2nd 2 weeks	Period III 3rd 2 weeks	Period IV 4th 2 weeks
A	+ Mn	− Mn	− Mn	− Mn
B	+ Mn	+ Mn	− Mn	− Mn
C	+ Mn	+ Mn	+ Mn	− Mn
D	+ Mn	+ Mn	+ Mn	+ Mn
E	− Mn	+ Mn	+ Mn	+ Mn
F	− Mn	− Mn	+ Mn	+ Mn
G	− Mn	− Mn	− Mn	+ Mn
H	− Mn	− Mn	− Mn	− Mn

Manganese as manganese chloride and iron as ferric citrate were supplied at concentrations of 0·5 p.p.m. manganese and 1·0 p.p.m. iron in the culture solution. After a two-week germination period in the absence of iron and manganese, the seedlings were transferred to the various treatments (four replicates of each). The culture solution was changed weekly.

The plants in treatment *A* showed symptoms of manganese deficiency in the upper leaves five weeks after the beginning of the treatment. The plants in treatments *B*, *C* and *D* were quite normal and were setting fruit on the first truss at the end of the experimental period. In the second series (treatments *E*, *F*, *G* and *H*), the following observations were made: (1) treatment *E* produced normal plants; (2) manganese-deficiency symptoms appeared in treatment *F* five weeks after sowing but plants recovered two days after manganese was supplied; (3) in treatment *G* the plants developed manganese-deficiency symptoms and only partially recovered from these when manganese was supplied; and (4) treatment *H* produced severe manganese-deficiency symptoms and no flowers were produced.

The average yield (Table 2) of plants from treatment *A* was significantly less than the yields produced by treatments *B*, *C*, *D* and *E*, all of which were equivalent to each other. The plants from treatments *F*, *G* and *H* reflect the delayed manganese supply in their low dry-weight yields. These observational and yield data indicate that, for normal development, from germination to the formation of young fruits on the first truss, manganese must be available at least for four weeks after the initial two-weeks growth in its absence.

Table 2

Treatment designation	Average dry weight (gm.)			Conc. of manganese in tops (p.p.m.)
	Roots	Tops	Whole plant	
A	1·09	10·19	11·28	10
B	1·43	12·45	13·88	62
C	1·88	12·30	14·18	120
D	1·66	13·74	15·40	123
E	1·54	12·80	14·34	109
F	0·99	6·78	7·77	120
G	0·41	4·08	4·49	94
H	0·33	3·44	3·77	5

From the manganese concentrations in the tissues (Table 2), it is clear that treatment *A* did not supply sufficient manganese, but that periods of treatment for the first four or more weeks provided adequate quantities for normal growth. This was also true when manganese was withheld for two weeks only (treatment *E* with 109 p.p.m. manganese). When manganese was available during the last four and two weeks of the experimental period, it accumulated to 120 and 94 p.p.m. respectively; but adequate utilization of this amount was not reflected in the dry-weight yields at the time of harvest. A response to this manganese might have been obtained if the experiment had been continued longer.

A further experiment was designed to investigate the manganese requirements during the first six weeks of growth. The treatments are summarized in Table 3.

Table 3

	Treatments: *J* 8 weeks with Mn	*K* 3rd and 4th weeks only with Mn	*L* 3rd week only with Mn	*M* 4th week only with Mn
Average dry weight of plants (gm.)	18·97	20·58	19·97	19·49
Conc. of manganese in tops (p.p.m. dry wt.)	108	46	27	25

All plants irrespective of treatment were normal at all stages, the dry-weight yields showed no significant difference between each other and the average manganese content of the tops was adequate (Table 3).

Thus, if manganese was available for only one week during the fifth or sixth week after sowing, no adverse effects resulted. It was observed that treatment *M* in the second experiment did not show any signs of manganese deficiency during the fifth week as did treatment *F* in the first experiment. This difference could only be attributed to external factors beyond control. It was unfortunate that a more comprehensive experiment was not possible at this stage. However, the results indicated that, for the period from germination to the setting of fruit on the first truss, manganese was necessary only during the fifth or sixth week after sowing. The manganese absorbed during this short period was sufficient for normal growth for a further five or four weeks. Addition of manganese to cultures deprived of this element for periods longer than six weeks had little beneficial effect by the end of the tenth week after sowing.

The work reported here was carried out in the University of Birmingham.

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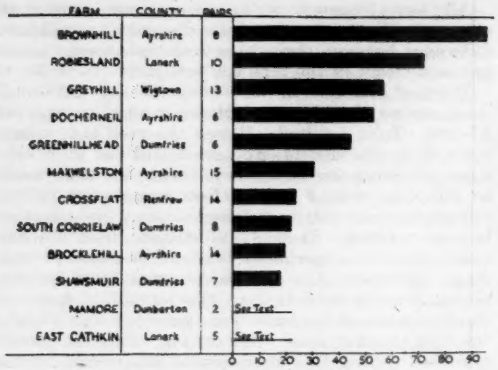
Feeding of Seaweed Meal to Lactating Cows

The butterfat production of lactating dairy cows in the west of Scotland has been shown to be increased by the single addition of copper sulphate to the diet one to six days after feeding the supplement[1]. The response to the feeding of foodstuffs rich in trace elements (including copper) should show a similar effect on the fat production of the cows in this area. Such a foodstuff is available as seaweed meal.

A supply of the meal (dried, milled *Ascophyllum nodosum*) was obtained from the Institute of Seaweed Research, Inveresk Gate, Musselburgh, and a sufficient quantity was distributed to seventeen West of Scotland dairy herds whose owners co-operated in the experimental work. The method adopted in drawing up the groups of animals for the experiment on those farms has already been described[1]. The meal was delivered to each farm in hundredweight canisters; and, in the experimental group, one scoopful (200 gm.) of the afternoon production ration in the feeding trough of each cow was measured back, and in its place a similar quantity of seaweed meal was substituted. The thorough mixing of the seaweed meal with the production ration was effected in the trough.

A number of cows in the experimental group (those which had calved six months or more beforehand) experienced difficulty in consuming the whole of the production ration containing the seaweed meal, and in five herds the experiment had to be terminated after a day or two. In the other twelve herds, however, despite occasional refusals, the meal continued to be fed for a period of three weeks to one month. After this time a further daily test of the milk and



Gm. butterfat per animal per day

fat production of the experimental and control animals was carried out.

The full results of the experiment are shown in the accompanying chart. The responses obtained in two of the herds (markedly positive in both cases) are not shown; in all the other herds the number of comparable pairs is six or more.

In all cases a positive response was obtained in the fat production of the animals after the inclusion of seaweed meal in the ration. The magnitude of the response varied greatly between cows and between herds. It is noteworthy, however, that in the case of some of the herds in which the response was greatest (Brownhill, Greyhill and Docherneil) the disease 'swayback' in lambs was experienced during the 1951 lambing season in the sheep flock. Swayback has been shown to be controlled by the administration of copper sulphate to the ewe immediately before lambing[2].

The results were examined by the staff at Rothamsted Experimental Station, from whom the following was received: "The treatment has a real effect although apparently not large enough to be detected on most single farms. The standard error is calculated from $SW\,(y - \bar{y}_w)^2$, where W is the number of pairs at a farm and is appropriate if the weights are inversely proportional to the within farm variances".

The storage of copper in the liver three days after drenching has been shown to be less than 10 per cent when comparable doses of copper sulphate (0·4–2 gm.) were administered to mature sheep. Usually the amount stored was less than 3 per cent of the dose administered[3].

In some herds the inclusion of seaweed meal in the ration (200 gm. per day) for a period of three weeks would appear to stimulate the fat production of the dairy cow to a greater extent than the administration of a single dose (10 gm.) of copper sulphate (cf. ref. 1).

Further experiments are being conducted to determine whether copper is the sole nutrient responsible for the increased fat production of the cow when seaweed meal is included in the ration.

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Electron Diffraction Study of the Hydrogen Bonds in Boric Acid

In recent years the techniques of X-ray diffraction structure analysis have been refined to such an extent that, with careful work, the positions of hydrogen atoms in a structure may be determined when each hydrogen atom is bound to a single atom. The detection of a hydrogen ion in a hydrogen bond, however, is a much more difficult task, since only a fraction of an electron can be considered as localized near the proton. This amount of ionization reduces the atomic scattering factor for X-rays. However, the atomic scattering factor for electrons is correspondingly increased since this is given by $\varepsilon = (Z - f)\lambda^2/\sin^2\theta$, where Z is the atomic number, f is the X-ray scattering factor, λ is the effective wave-length of the electron beam and θ is the Bragg angle. Hence, hydrogen ions in hydrogen bonds should be detected more readily in structure analyses based on electron diffraction data. Techniques for structure analysis using single-crystal electron diffraction patterns have been evolved and will be described elsewhere. They have been applied to the study of the structure of boric acid layers.

Zachariasen[1] has shown that boric acid has a layer lattice structure. The layers are composed of planar BO_3^{3-} groups joined by hydrogen bonds, and have hexagonal symmetry. These layers are stacked in such a way that the unit cell is triclinic and contains portions of two layers.

Boric acid crystals, formed by evaporation from aqueous solution, which are small enough to give good single-crystal spot patterns (that is, a few hundred angstroms in thickness and a few microns in diameter) show a high degree of disorder in the stacking of the layers. Observations on a number of substances seem to indicate that such stacking disorder occurs almost without exception in very small crystals with layer-lattice structure. Many of the 'two-dimensional' or 'cross-grating' spot patterns reported in the literature may be explained in this way.

If the stacking of the layers were completely random except that all layers had the same orientation, the diffraction pattern would be the same as that of a single layer. For boric acid, although the electron diffraction spot patterns show very nearly a hexagonal symmetry when the beam is perpendicular to the plane of the layers, the intensities deviate slightly from those to be expected for complete randomness.

A method has been developed whereby the amount and nature of the stacking order can be determined provided that the structure of the layer is known approximately, and this information can be used for deriving the intensities corresponding to a single layer from the observed intensities. The details of this method will be published elsewhere.

The intensities measured from a single-crystal electron diffraction pattern, taken with the beam nearly perpendicular to the layers, were corrected in this way. The Fourier projection of the potential distribution in a boric acid layer, calculated from the corrected intensities, is shown in Fig. 1. The atomic positions are indicated clearly. The groups of three oxygen atoms surrounding a boron atom, and the arrangement of these groups in the unit cell, are exactly as found by X-ray work. However, whereas Zachariasen assumed that the hydrogen ions were located half-way between two oxygen atoms, it is

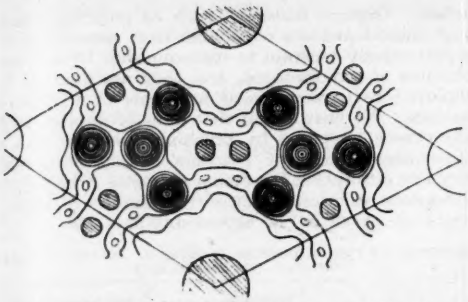

Fig. 1. Fourier projection of a boric acid layer. The full contours mark equal increments in potential in arbitrary units. The dotted contour represents a half increment

seen that the most favoured position for the hydrogen ions is close to one or the other of the two oxygens. The O—H distance is approximately 1·05 A. The hydrogen bonds occur in pairs between pairs of oxygen atoms in adjacent BO_3^{3-} groups, and it is to be noted that the hydrogen positions do not lie on straight lines between oxygen atoms as might be expected, but are displaced in each case towards the neighbouring hydrogen bond. This appears to result from a tendency for the formation of a hydrogen bond from an oxygen atom not only to its nearest neighbour in the adjacent BO_3^{3-} group, but also diagonally across to its second nearest neighbour. For such a diagonal bond it is to be expected that the most favoured position for the hydrogen ion would be approximately 1 A. from an oxygen atom. The resulting hydrogen distribution may be considered as resulting from the combination of the canonical arrangements shown in Fig. 2.

It seems probable that this type of interaction between parallel hydrogen bonds may occur in many crystals where the geometry of the structure is favourable, and may play an important part in determining the structure of some organic compounds, such as the carboxylic acids, and proteins.

Another point of interest in the Fourier projection (Fig. 1) is that the boron and oxygen peaks are very nearly equal in height in spite of the large relative difference in atomic numbers. This effect may be ascribed to the state of ionization of the atoms. The intensities of electron diffraction spots are much more sensitive to the degree of ionization than are the X-ray diffraction intensities, particularly for spots of low indices. Cations have more, and anions less, scattering power than the corresponding neutral atoms. Hence it seems possible that different ionization states may be distinguished readily by such an electron diffraction structure analysis.

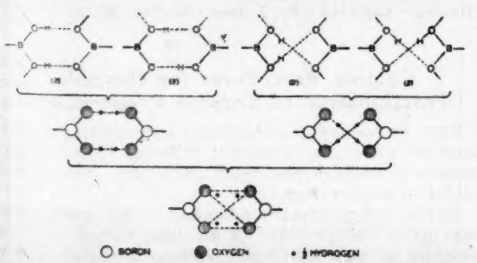

Fig. 2. Combination of arrangements of hydrogen ions in hydrogen bonds between four oxygen atoms to give the observed distribution

I wish to express my gratitude to Dr. A. L. G. Rees for discussion on the interpretation of the hydrogen-bond configuration.

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Intermolecular Force and Transport Coefficients

The Chapman–Enskog theory of non-uniform gases expresses the transport properties in terms of a set of collision integrals[1] which depend on the law of molecular interaction. These integrals have been evaluated for various molecular models and the computed values of the transport coefficients have been compared with the experimentally observed values by Chapman and Cowling. Hirschfelder, Bird and Spotz[2], Winter[3] and others have shown that the Lennard-Jones 12 : 6 potential energy function

$$E(r) = 4\varepsilon\,[\,(r_0/r)^{12} - (r_0/r)^6\,] \qquad (1)$$

is more in accord with the observed properties of gases than any other model, but the values of the force constants ε and r_0 employed by them were deduced from viscosity data. It is well known that the coefficient of thermal diffusion is far more sensitive to the type of molecular interaction than the three elementary gas coefficients. We have, therefore, utilized the data on thermal diffusion, and in particular the variation of the thermal separation ratio R_T of argon isotopes with temperature, to calculate the force constant ε.

As shown by Jones and Furry[4] and others, R_T for the case of isotopes is given by:

$$R_T = \frac{16{\cdot}9\,(C-1)\,(1+A)}{A\,(11-4B+8A)}, \qquad (2)$$

where A, B, C are known functions of the various collision integrals $W^l(n\,;\,kT/\varepsilon)$. Equation (2) shows that R_T does not involve r_0 and depends only on ε and T. It is therefore possible to calculate ε from equation (2) for argon at different temperatures, quite independently of whether r_0 is constant or not, by plotting R_T ε versus T and R_T (from equation 2) versus x, where $x = kT/\varepsilon$. Comparison of the two curves at various corresponding points readily gives ε at different temperatures, the values thus obtained being given in the accompanying table (col. 2). These values of ε are much more accurate than those obtained by others from viscosity and virial coefficient data, since this method, in addition to being far more sensitive, does not assume the constancy of r_0.

The figures in the table show clearly a slow decrease in the value of ε with decrease of temperature. It is true that the experimental values of R_T have the

Temp. (° K.)	ε/k (° K.)	r_0, in A., from viscosity	r_0, in A., from self-diffusion
130	115·0	3·473	3·473
140	116·6	3·468	3·447
160	120·3	3·443	3·432
180	120·0	3·449	3·424
250	135·1	3·370	3·337
300	142·9	3·344	3·319
350	152·2	3·321	3·295
400	158·1	3·309	
480	165·5	3·300	
530	168·3	3·293	

most probable errors of ± 5 per cent, which is likely to produce an error of ± 15 per cent in the value of ε at high temperatures and of about ± 5 per cent at very low temperatures. Nevertheless, the decrease in the value of ε is definite and unmistakable, though the magnitudes may be much in error. These investigations thus show that the 12 : 6 potential function can represent the interaction even over a long range of temperatures, provided ε and r_0 (as will be seen later) are varied very slowly with temperature. Exact calculations by us from viscosity data also show an unmistakable tendency for ε to increase with increase of temperature. Using these values of ε in the expressions for viscosity and self-diffusion, r_0 at different temperatures has also been found, the values being given in the table.

This variation of ε and r_0 can be accounted for theoretically. Writing equation (1) in the form :

$$E(r) = \lambda r^{-12} - \mu r^{-6}, \qquad (3)$$

it can be shown that

$$\varepsilon = \tfrac{1}{4}\mu^2/\lambda, \quad r_0 = (\lambda/\mu)^{1/6}, \qquad (4)$$

where μ and λ are supposed to remain constant. From London's quantum-mechanical formula for the dispersion energy leading to the van der Waals' attraction[5] :

$$E(r) = - \mu r^{-6} - \mu' r^{-8} - \mu'' r^{-10} - \ldots \qquad (5)$$

it is evident that if, for large distances, we limit the formula to the first term only, μ must be made to increase when the intermolecular distance r is decreased, in order that the single term may still give the attraction correctly. Since at higher temperatures the most effective contribution of the molecular field to the transport properties will be for smaller intermolecular distances, it follows that μ must increase with increase of temperature. Similarly, it can be shown that the repulsion term λ must decrease with rise of temperature. In consequence, ε will increase and r_0 will decrease with rise of temperature. In fact, from equations (4) the effective μ and effective λ can be calculated at different temperatures and are found to be fully consistent with the virial coefficient data. A similar procedure has been used for other gases also. Detailed investigations are being published in a series of papers.

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Ion-exchanging Surfaces in Radiological Decontamination

The adsorption of radioelements by the walls of glass vessels is recognized as a source of inaccuracy in radiochemical assessments, and the great affinity shown by many radioactive substances for working surfaces in the laboratory is shown by the vigorous chemical and mechanical treatments which are needed for their removal from these surfaces. Chemically resistant metals such as stainless steel and lead have been shown[1] to adsorb phosphorus-32, barium-140 and iodine-131, and complete removal was possible only by removing a thin layer of the surface. Organic materials such as polythene[2] and vinyl chloride-acetate copolymer have been found to be particularly resistant to contamination by aqueous solutions of radioisotopes, and they are extensively employed as constructional materials or protective coatings. We have found that films of unplasticized polystyrene, prepared by brushing a surface with a 30 per cent solution of 'Distrene' in toluene, possess very low adsorption for fission elements (which were in aqueous solution as nitrates). Results of experiments are given in the accompanying table.

Retention of Fission Product Isotopes by Polystyrene and Sulphonated Polystyrene

Surface	Beta/gamma count after 1 min. immersion in fission products solution (10,000 counts min.$^{-1}$, c.c.$^{-1}$)	Beta/gamma count after washing with 5 per cent ammonium citrate for 3 min.
Polystyrene	108 counts/min. 58 65 85	5 counts/min. 3 2 19
Sulphonated polystyrene (prepared by exposing to SO_3 for 2 min.)	769 1,091 1,470 1,140	7 114 235 44

It was considered that decontamination might be more readily effected if a surface could be rendered ion-exchanging by some means, since it has been established[3] that isotopes of rare-earth elements can be adsorbed on ion-exchanging phenol formaldehyde resins and can afterwards be completely removed by treating the resin surface with an elutriating solution of citric acid. We have recently carried out a comprehensive series of experiments to determine the degree of attachment and relative ease of removal of fission elements from sulphonated polystyrene, which we prepared in the laboratory, and have come to the conclusion that the use of a cation-exchanging material of this kind does not facilitate complete decontamination to the extent that might have been expected. Full details will be reported in due course, but the table shows typical results.

It will be seen that the adsorption of fission elements is higher for the ion-exchanging surface and that elutriation does not bring the final level of activity down to that of untreated polystyrene.

We are indebted to the Admiralty for permission to publish this note.

E. W. Jackson
L. Garrard

Admiralty Research Laboratory,
Teddington, Middlesex.
Dec. 11.

[1] Tompkins and Bizzell, *Indust. and Eng. Chem.*, **42**, 1469 (1950).
[2] *Fay Atomics*, **3**, 93 (1952).
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Column Procedures for the Salt Fractionation of Enzyme Preparations

Two procedures for fractionating enzyme preparations on a column, somewhat different from the previously described chromatopile[1], have been found useful in preliminary tests.

In the first procedure, a column of the precipitated enzyme in the presence of an inert carrier and in a medium of high salt concentration is eluted with a dilute salt solution. The resulting fractions of effluent are then analysed for enzyme activity and for protein.

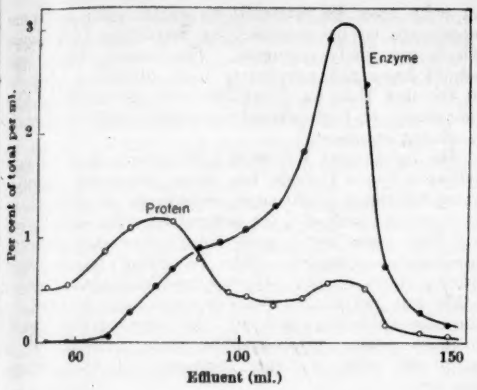

Fig. 1

For example, 50 ml. of saturated ammonium sulphate was added to 25 ml. of a concentrated culture fluid of *B. macerans*[3]. The slurry resulting from the addition of 15 gm. of 'Celite' was poured into a tube and washed with one-third saturated ammonium sulphate, and the effluent was analysed for starch-degrading activity[3] and 'protein' (turbidity of trichloracetic acid suspensions). The results are shown in Fig. 1.

In the second procedure, the impure enzyme preparation in dilute salt solution is allowed to pass down a column consisting of a water-absorbing, insoluble substance. The activity and protein are then eluted with a dilute solution and the effluent fractions are analysed as in the first procedure. For example, 25 ml. of an impure malt alpha-amylase preparation in 0·4 saturated ammonium sulphate was allowed to pass down a column consisting of 60 gm. of calcium sulphate hemihydrate. The amount of the latter was calculated from the experimental dead space of the column on the assumptions that a salt concentration gradient was to be established on the column ranging from 0·4 saturated to 0·7 saturated ammonium sulphate and that hemihydrate would take up the theoretical amount of water. The column was then washed with saturated calcium sulphate solution at 5°. The results are shown in Fig. 2. Equally effective fractionations were obtained using other amylase sources.

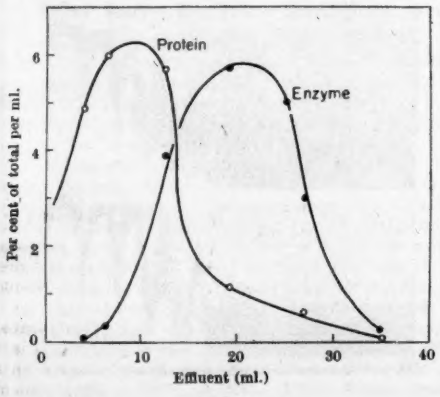

Fig. 2

The effectiveness of both these methods was probably due to the differential extraction-rates of the proteins[3], and possibly to the establishment of salt concentration gradients along the columns. Such a gradient might possibly be established upon properly impregnated paper. In principle, one might use a procedure of the type herein described as a specific activity – solubility test for purity[4].

SIGMUND SCHWIMMER
Western Regional Research Laboratory,
U.S. Department of Agriculture,
Albany, California.
Aug. 12.

[1] Mitchell, H. R., and Haskins, F. A., *J. Biol. Chem.*, **180**, 1071 (1949).
[2] Schwimmer, S., and Garibaldi, J. A., *Cereal Chem.*, **29**, 108 (1952).
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An Electrostatic Single Lens permitting Rigorous Calculation

ALTHOUGH for magnetic electron lenses the field[1]

$$B_z(z) = B_0/[1 + (z/a)^2] \qquad (1)$$

is known to permit rigorous calculation, this is not the case for electrostatic single lenses as used in electrostatic microscopes, for which up to now no type permitting exact calculation was known. We shall show in the following that the electrostatic counterpart to (1), namely:

$$\Phi(z) = \Phi_0 - \Phi_0 x^2/[1 + (z/a)^2] \; ; \; 0 < x^2 \leqq 1 \qquad (2)$$

is also integrable. The differential equation of paraxial rays for this field, which approximates very well to the axial potential distribution of a three-aperture lens, can be transformed into an equation with constant coefficients. A magnetic field of the Glaser-type can be superposed. Inserting in

$$\sqrt{\phi}\, \mathrm{d}(\sqrt{\phi}\, \mathrm{d}r/\mathrm{d}z)/\mathrm{d}z + [\tfrac{1}{4}\, \Phi'' + eB_z^2/8m]\, r = 0 \qquad (3)$$

the new variables v, φ:

$$z = a \,.\, \mathrm{ctg}\, \varphi \; ; \; r = v(\varphi)/\sin \varphi, \qquad (4)$$

which is well known from the bell-shaped field (1), we get:

$$\sqrt{\phi}\, \mathrm{d}(\sqrt{\phi}\, \mathrm{d}v/\mathrm{d}\varphi)/\mathrm{d}\varphi + [\Phi + \tfrac{1}{4}\, (\mathrm{d}^2\phi/\mathrm{d}\varphi^2) + ea^2B_z^2/(8m \sin^4\varphi)]\, v = 0. \qquad (5)$$

The fields (1) and (2) become:

$$\Phi = \Phi_0\, (1 - x^2 \sin^2\varphi) \; , \; B_z = B_0 \sin^2\varphi. \qquad (6)$$

Inserting in (5) we obtain

$$\sqrt{1 - x^2 \sin^2\varphi}\, \mathrm{d}(\sqrt{1 - x^2 \sin^2\varphi}\, \mathrm{d}v/\mathrm{d}\varphi)/\mathrm{d}\varphi + [1 + k^2 - \tfrac{1}{4}x^2]\, v = 0 \; ; \; k^2 = \frac{eB_0^2a^2}{8m\Phi_0}. \qquad (7)$$

Changing the independent variable by means of

$$\mathrm{d}\varphi/\mathrm{d}\tau = \sqrt{1 - x^2 \sin^2\varphi}, \qquad (8)$$

we get

$$\mathrm{d}^2v/\mathrm{d}\tau^2 + \omega^2 v = 0, \quad \omega^2 = 1 + k^2 - \tfrac{1}{4}x^2, \qquad (9)$$

and the solutions:

$$v = A \cos \omega\tau + B \sin \omega\tau. \qquad (10)$$

The variable τ is, from (8), given by the elliptic integral of the first kind:

$$\tau = \int_0^{\varphi} \frac{d\varphi}{\sqrt{1 - \varkappa^2 \sin^2\varphi^2}}; \text{ or } \varphi = \text{am } \tau. \quad (11)$$

The paraxial electron trajectories are

$$r = (A \cos \omega\tau + B \sin \omega\tau)/\sin(\text{am } \tau) = C \sin(\omega\tau - \delta)/\text{sn } \tau \quad (12)$$

with

$$z = a \,.\, \text{ctg}(\text{am } \tau) = a \,.\, \text{cn } \tau/\text{sn } \tau = a \,.\, \text{cs } \tau. \quad (13)$$

Since these functions are tabulated exhaustively, the trajectories are known numerically. The calculation can be carried out on similar lines for the slightly generalized case,

$$\Phi = \Phi_0 + (A + Bz)/[1 + (z/a)^2] \; ; \; A \gtrless 0. \quad (14)$$

Mirror effects can be discussed. Third-order aberration coefficients have been calculated. It was even possible to determine the electron paths everywhere, without restriction to the neighbourhood of the optical axis. This can be done by reduction to the problem of two centres. The results will be published in detail in another journal.

I am indebted to Prof. W. Glaser for several discussions on the subject and for the opportunity of carrying out this work in his Institute.

Peter Schiske

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Nov. 14.

[1] Glaser, W., *Z. Phys.*, **117**, 285 (1941).

Long-Delay Ionospheric Echoes at 150 kc./s.

It is well known that in the ionosphere (a doubly refractive medium) a radio wave splits into two components, commonly designated as the ordinary and extraordinary modes. The propagation characteristics of the medium are determined from the corresponding ordinary and extraordinary indices of refraction. The modes may be appreciably coupled in certain ionospheric regions[1], depending upon the wave-frequency and other factors.

A common experimental technique used for studying these split components, at certain frequencies, involves the use of pulsed radio soundings, in which the components are received as echoes separated in time, since their corresponding heights of reflexion are different. These split echoes are commonly observed near the critical frequencies of the layer.

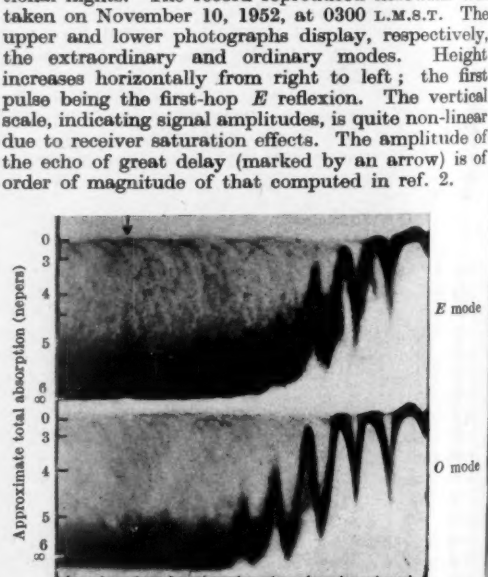
At the much lower frequency of 150 kc./s., the extraordinary mode does not usually, if ever, encounter a 'reflexion condition' below the maximum electron density in the *E*- and *F*-regions; and no great effort has hitherto been directed towards the further tracing of this component into the upper ionosphere. A recent analysis by us[2] employing an estimated equinox, midnight ionospheric model has indicated a strong possibility of substantial reflexion of the 150 kc./s. extraordinary component, from a region well above the maximum in electron density of the F_2 layer. This region corresponds to a 'fourth condition for reflexion'[3], and contains extremely rapid variations of refractive index with height. The analysis, involving laborious wave solutions by a special technique[4], indicates virtually total reflexion from a height of 940 km. in the assumed model. Absorption considerations indicate, further, that such an echo may be returned to earth with sufficient amplitude to be recorded by recording techniques which are fairly common. The reason why these echoes have not previously been observed may lie in the fact that no effort has been devoted, at this frequency, to high-altitude searching with high-gain receiving equipment.

The Ionosphere Research Laboratory at the Pennsylvania State College has been procuring regular, extended-range night-time recordings on 150 kc./s., at vertical incidence, for several months, employing a 2-MW. peak power pulse-transmitter and sensitive receiving equipment. The recording height-range during most of the observations extended beyond 1,200 km., with the receiver sensitivity limited by the atmospheric noise-level. To improve the signal-to-noise ratio, photographic time integration is employed, with a 5-min. exposure of 12·5 sweeps per sec.

Occasional 'isolated' echoes have been observed in the range 600–900 km., some of these undoubtedly belonging to the multiple hop system of echoes from the *E*-region, but augmented by ionospheric focusing. The signals were received on a single fixed-loop aerial and no polarization data were available.

Recently, however, a circularly polarized receiving-aerial system has been employed, making possible simultaneous recordings of the unsplit ordinary and extraordinary components. This modification was suggested by polarization considerations of the '940-km. echo' being sought, the latter containing an ordinary to extraordinary amplitude ratio that should be roughly inverse to the same ratio of the multiple-*E* hop system[5]. The 5-min. recordings were taken every 30 min. during the hours 2000–0400 L.M.S.T.

On the night of November 9, 1952, there appeared, on three different records, an isolated echo corresponding to a height of approximately 900 km. They were visible only on the extraordinary mode. These were followed by similar observations on two additional nights. The record reproduced herewith was taken on November 10, 1952, at 0300 L.M.S.T. The upper and lower photographs display, respectively, the extraordinary and ordinary modes. Height increases horizontally from right to left; the first pulse being the first-hop *E* reflexion. The vertical scale, indicating signal amplitudes, is quite non-linear due to receiver saturation effects. The amplitude of the echo of great delay (marked by an arrow) is of order of magnitude of that computed in ref. 2.



Among the possibilities for the interpretation of these long-delay echoes are: (*a*) ionospheric focusing of *E* reflexions, (*b*) oblique reflexions from distant ion clouds in the *E*-region, (*c*) large delays due to lateral deviation[6,7], and (*d*) reflexions from the 'fourth reflexion condition', above the maximum of the F_2-layer. Ionospheric focusing is immediately ruled out by the fact that the echo polarization is radically different from that of the *E* hops. Other records containing a definite focusing phenomenon do not show the reversed mode that is observed on the long-delay echoes. Oblique reflexions of detectable amplitudes would require an oblique surface of such proportions as to make this explanation extremely unlikely. No calculations have been made on possible time-delays due to lateral deviation; but it does not, at present, seem likely that this could account for the amplitudes and the time-delays of the orders observed.

We believe there is a strong possibility that these long-delay echoes are reflexions from above the maximum of ionization density in the F_2-region, and that the reflexion mechanism corresponds to the 'fourth condition for reflexion'. It is hoped that future observations will add further evidence regarding this possibility.

This investigation has been supported by the National Science Foundation under Grant NSF–066 and, in part, by the Geophysics Research Division of the Air Force Cambridge Research Center under Contract AF19(122)–44.

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Dec. 20.

[1] Gibbons, J. J., and Nertney, R. J., *J. Geophys. Res.*, **57**, No. 3 (Sept. 1952).
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[4] Gibbons, J. J., and Schrag, R. L., *J. App. Phys.*, **23**, No. 10 (Oct. 1952).
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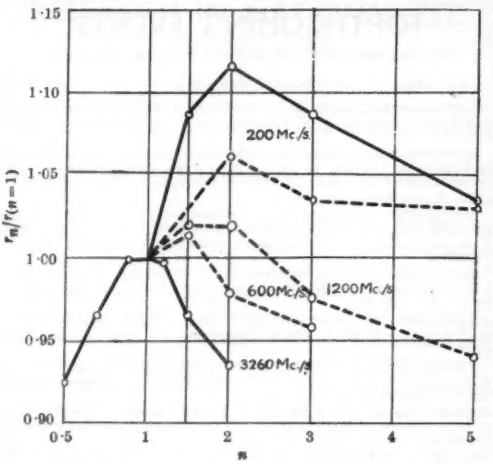
A Method of Analysis of the Directivity of Solar Radio Emission from Sunspots

It has been reported previously that the daily values of intensity of solar radio emission are approximately proportional to the whole disk Wolf's sunspot relative number or sunspot area[1,2]. On the other hand, there is a tendency for the intense radiation to be observed when active sunspots are near the central meridian, especially in the metre wavelength region. If the solar radio emission has such a tendency, the daily values of solar radio emission will show better correlation with the sunspot relative number, $nA_1 + A_2$, than the whole disk sunspot relative number, $A_1 + A_2$, where A_1, A_2 indicate Wolf's relative sunspot number in the central-circle zone (half-diameter circle) and in the outer zone respectively, and n is a parameter which indicates the importance of the sunspots located in the central-circle zone compared with those in the outer zone. To investigate the directivity of solar radio emission from the sunspots quantitatively, the value of n to give a maximum correlation coefficient was determined.



Correlation coefficient r between solar radio emission and sunspot number versus n, which indicates the importance of the sunspots located in the central circle zone compared with the sunspots in the outer zone. ———, May to August 1951; – – –, January to June 1951

In the accompanying graph the correlation coefficient r, between solar radio emission at 3,260 Mc./s. observed at our observatory and the sunspot relative number, is plotted against n, and this is compared with the radio emission at 200 Mc./s. observed at Tokyo Astronomical Observatory in Japan, and 600 Mc./s. and 1,200 Mc./s. observed at Pott's Hill, Sydney; the solid lines are for observations from May to August 1951, dotted lines for those from January to June 1951. The sunspot number is taken from the Tokyo Astronomical Observatory Report.

As shown in the graph, the correlation coefficients between solar radio emission and sunspot relative number have the following maxima:

$n = 1{\cdot}0$ at 3,260 Mc./s. and $r_{max.} = 0{\cdot}86 \pm 0{\cdot}02$ (May–August 1951)
$n = 2{\cdot}0$ „ 1,200 „ „ „ $= 0{\cdot}68 \pm 0{\cdot}04$ (January–June 1951)
$n = 1{\cdot}5$ „ 600 „ „ „ $= 0{\cdot}54 \pm 0{\cdot}05$ („)
$n = 2{\cdot}0$ „ 200 „ „ „ $= 0{\cdot}54 \pm 0{\cdot}05$ („)
$0{\cdot}49 \pm 0{\cdot}06$ (May–August 1951)

Unfortunately, the standard errors are large at 200, 600 and 1,200 Mc./s. compared with the variations of $r_n/r_{(n-1)}$ shown in the graph, so the results obtained at these frequencies by this method are almost meaningless. The directivities at these frequencies are therefore being investigated using another method of analysis; but it also shows a tendency to result in similar directivities.

It may be concluded that the solar radio emission at 3,260 Mc./s. from sunspots can be observed on the earth at almost equal intensity whatever the location of the sunspots; but at present the directivities are not clear quantitatively at other frequencies.

It is also doubtful if these directivities may be applied to the radio emission at bursts or outbursts.

I should like to express my thanks to Mr. Martin Ryle, of the University of Cambridge, for his helpful criticism.

T. Takakura

Osaka City University,
Ohgimachi, Osaka.

[1] Waldmeier, M., and Müller, H., *Z. Astrophys.*, **27**, 58 (1950).
[2] Christiansen, W. N., and Hindman, J. V., *Nature*, **167**, 635 (1951).

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public)*

Monday, March 9

University of London (at Bedford College, Regent's Park, London, N.W.1), at 5.15 p.m.—Prof. S. Bergstrom: "Intestinal Absorption of Fats".*

Institution of Electrical Engineers (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "Is the Presentation of Technical Literature Adequate?" (to be opened by Prof. M. G. Say).

Manchester Literary and Philosophical Society (in the Reynolds Hall, College of Technology, Manchester), at 5.30 p.m.—Prof. R. A. Fisher, F.R.S.: "The Evolution of Genetics" (Ramsden Memorial Lecture).*

Royal Geographical Society (at 1 Kensington Gore, London, S.W.7), at 5.30 p.m.—"Western Nepal" (Colour films with commentary by Mr. O. Polunin).

University of London (at King's College, Strand, London, W.C.2), at 5.30 p.m.—Prof. R. Plank (Karlsruhe): "Entropy and Probability".*

Pharmaceutical Society (at 17 Bloomsbury Square, London, W.C.1), at 7.30 p.m.—Dr. J. H. Burn, F.R.S.: "Progress in Biological Standardization".

Royal Institute of Chemistry, London Section (joint meeting with the Woolwich Polytechnic Scientific Society, at the Woolwich Polytechnic, Woolwich, London, S.E.18), at 7.30 p.m.—Dr. A. G. Maddock: "Developments in Experimental Techniques of Radio Chemistry".

Tuesday, March 10

Zoological Society of London (at the Zoological Gardens, Regent's Park, London, N.W.1), at 5 p.m.—Scientific Papers.

Royal Institution (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Prof. G. C. Varley: "The Causes of Insect Abundance". (Further Lectures on March 17 and 24).

Institution of Chemical Engineers (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Mr. J. M. Coulson and Mr. R. R. Mehta: "Heat Transfer Coefficients in a Climbing Film Evaporator"; Mr. F. E. Warner and Mr. K. A. R. Julian: "Natural Circulation in External Evaporators".

Institution of the Rubber Industry (at the Royal Society of Tropical Medicine and Hygiene, 26 Portland Place, London, W.1), at 5.30 p.m.—Mr. L. Landau: "Some Aspects of Latex Dipping"; at 7 p.m.—Mr. J. M. Buist: "Ageing and Weathering of Rubber, and Methods of Assessment".

British Institution of Radio Engineers, London Section (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 6.30 p.m.—Discussion on "The Standardization of Symbols and the Arrangement of Electronic Circuit Diagrams" (to be opened by Mr. L. H. Bainbridge-Bell).

Wednesday, March 11

Society of Public Analysts and other Analytical Chemists, Biological Methods Group (joint meeting with the Food Group of the Society of Chemical Industry and the British Region of the Biometric Society, at the Wellcome Research Foundation, 183 Euston Road, London, N.W.1), at 2.30 p.m.—Symposium on "Flavour Assessment".

Institution of Electrical Engineers, Radio Section (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. E. McP. Leyton, Mr. E. A. Nind and Mr. W. S. Percival: "Low-Level Modulation Vision Transmitters, with special reference to the Kirk O'Shotts and Wenvoe Stations".

University of London (at King's College, Strand, London, W.C.2), at 5.30 p.m.—Prof. R. Plank (Karlsruhe): "Steam Jet Refrigeration".*

Thursday, March 12

Royal Society (at Burlington House, Piccadilly, London, W.1), at 11 a.m.—Discussion on "The Function and Location of Enzymes in Cells" (to be opened by Prof. J. Z. Young, F.R.S.).

Royal Society of Arts, Commonwealth Section (at John Adam Street, Adelphi, London, W.C.2), at 5.15 p.m.—Prof. Raymond W. Firth: "Social Changes in the Western Pacific".

University of London (at Bedford College, Regent's Park, London, N.W.1), at 5.15 p.m.—Prof. S. Bergstrom: "Formation and Interconversion of Bile Acids".*

Institute of Welding (joint meeting with the Institution of Structural Engineers, at 11 Upper Belgrave Street, London, S.W.1), at 6 p.m.—Mr. E. M. Lewis: "Construction of the New Testing Laboratory of the British Welding Research Association at Abington".

Royal Aeronautical Society (in the Rolls-Royce Welfare Hall, Nightingale Road, Derby), at 6.15 p.m.—Squadron-Leader W. A. Waterton: "Some Aspects of High Performance Jet Aircraft".

Friday, March 13

Society of Dyers and Colourists, Manchester Section (in the Great Hall, College of Technology, Manchester), at 2 p.m.—Symposium on "Synthetic Fibres".

Royal Astronomical Society (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Scientific Papers.

Physical Society (at the Science Museum, Exhibition Road, London, S.W.7), at 5 p.m.—Prof. M. Born, F.R.S.: "The Conceptual Situation in Physics and its Prospects of Development" (Guthrie Lecture).*

Bedson Club (in Lecture Theatre I, Chemistry Building, King's College, Newcastle-upon-Tyne), at 5.30 p.m.—Dr. F. Fairbrother: "Catalytic Inorganic Halides and the Friedel-Crafts Reaction" (89th Bedson Lecture).

Institution of Mechanical Engineers (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—"Steels for Steam Power Plant": a review of work of a Sub-Committee of the British Electrical and Allied Industries Research Association between 1930 and 1951, compiled by A. M. Sage.

University of London (at King's College, Strand, London, W.C.2), at 5.30 p.m.—Prof. R. Plank (Karlsruhe): "Absorption Refrigeration".*

Royal Institution (at 21 Albemarle Street, London, W.1), at 9 p.m.—Prof. L. Hawkes, F.R.S.: "Geology and Time".

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Chemist (Senior Scientific Assistant) at the Central Laboratory, Chiswick, with responsibility for section concerned with wide variety of analytical and investigational work other than metals, fuels, lubricants and paints—The Staff Officer (F/EV.229), London Transport, 55 Broadway, London, S.W.1 (March 13).

Assistant Chemist and Bacteriologist—The Chief Engineer, Mid-Wessex Water Company, Frimley Green, Aldershot (March 14).

Assistant Inspector of Fisheries and Pollution—The Clerk to the Avon and Dorset River Board, Rostherne, 3 St. Stephen's Road, Bournemouth (March 14).

Experimental Officers in the Guided Weapons Department, Royal Aircraft Establishment, Farnborough, for work on design, development and performance of new weapons and associated guidance and control systems; instrumentation of flight trials and investigation of trials results—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26 King Street, London, S.W.1, quoting D.508/52A (March 14).

Assistant Keeper (with honours degree in zoology or equivalent) in Zoology in the Manchester Museum—The Registrar, The University, Manchester 13 (March 20).

Senior Scientific Officer at the High-Speed Aerodynamics Laboratory, Salisbury, Australia, to be responsible, under the direction of a Principal Scientific Officer, for research into problems of stability and control at high speeds—The Senior Representative, Department of Supply, Canberra House, 87 Jermyn Street, London, S.W.1 (March 20).

Instructor/Lecturer of Forestry Field Training School, Forest Department, Ceylon—The High Commissioner for Ceylon in London, 13 Hyde Park Gardens, London, W.1 (March 21).

University Demonstrator in Physics—Dr. F. B. Kipping, Chemical Laboratory, Cambridge (March 21).

Lecturer in Physiology—The Dean of the Medical College, St. Bartholomew's Hospital, West Smithfield, London, E.C.1 (March 25).

Principal (with an industrial background, considerable administrative experience in education, and an intimate knowledge of the whole field of technical education) of the Technical-Vocational High School, Winnipeg—The Secretary-Treasurer, School District of Winnipeg, Winnipeg, Man., Canada; or The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (April 1).

Tutor (Crop Husbandry) and a Tutor (Animal Husbandry) to train staffs of Departments of Agriculture and others in the practice and theory of agriculture at sub-university level—The Principal, Eastern Caribbean Farm Institute, Arima P.O., Trinidad, B.W.I. (April 1).

Head of the Department of Biochemistry—The Academic Secretary, Weizmann Institute of Science, Rehovoth, Israel (April 15).

Agriculturist (with a degree in agriculture, preferably with technical, industrial or administrative experience) at the Technical and Scientific Register—The Ministry of Labour and National Service (K Section), Almack House, 26 King Street, London, S.W.1, quoting G.6/53A.

Analytical Chemist (temporary) for work arising from experiments with farm animals—The Secretary, Rowett Research Institute, Bucksburn, Aberdeenshire.

Assistant Lecturer (Grade B) in Electrical Engineering—The Registrar, Hatfield Technical College, Roe Green, Hatfield, Herts.

Assistant Works Manager (with honours degree in chemistry or chemical engineering, A.R.I.C., A.M.I.Chem.E., or equivalent) for Atomic Energy Factory at Salwick, Preston, to be responsible for operation of chemical plants—The Ministry of Supply, Division of Atomic Energy (Production), Risley, Warrington, Lancs, quoting Ref. 425.

Electrical or Mechanical Engineer (Scientific Officer grade) at the Royal Aircraft Establishment, Farnborough, for research and development in connexion with generation, conversion and control of electric power for aircraft—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26 King Street, London, S.W.1, quoting D.54/53A.

Lecturer in Chemistry, a Lecturer in Physics, a Lecturer in Mathematics, a Lecturer in Zoology and Botany, an Assistant for Geography and English, and an Assistant for Mathematics—The Principal, Adisadel College, Cape Coast, Gold Coast (by air mail).

Scientific Assistant, mainly to examine and abstract world scientific literature on grassland and field-crop research—The Director, Commonwealth Bureau of Pastures and Field Crops, Aberystwyth.

Scientists (M.A., M.Sc. or Ph.D. or equivalent in one of the physical sciences, mathematics, biomathematics, or mathematical economics, preferably with some industrial or laboratory research experience) for Operational Research and Systems Analysis—The Director, Research Personnel, Defence Research Board, Department of National Defence, 'A' Building, Ottawa, Canada.